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Rutherford
ELECTRONICS CO.

INSTRUCTION BOOK

PULSE GENERATOR
MODEL B-5

Serial No. 182

8944 LINDBLADE ST., CULVER CITY, CALIF.

INSTRUCTION BOOK

PULSE GENERATOR
MODEL B-5

Serial No. 182

Price $7.50

Rutherford ELECTRONICS CO.
8944 LINDBLADE ST., CULVER CITY, CALIF
TExas 0-7393

MODEL B-5 INSTRUCTION BOOK

GENERAL DESCRIPTION:

The Model B-5 is a high speed pulse generator producing pulse trains having repetition rates up to ten megacycles per second. Its output pulse is adjustable in width from twenty millimicroseconds to twelve and one-half microseconds and has rise and fall times less than eight millimicroseconds. Continuously variable repetition rate and pulse width permit study of high speed switching circuits.

SPECIFICATIONS:

Pulse Repetition Rate - Continuously variable from 1 cycle/sec. to 10 mc/c in seven ranges

1 c/s to 10 c/s
10 c/s to 100 c/s
100 c/s to 1 kc/s
1 kc/s to 10 kc/s
10 kc/s to 100 kc/s
100 kc/s to 1 mc/s
1 mc/s to 10 mc/s

External Trigger Pulse - 8 V minimum with rise time less than .1 us

Pulse Width - Continuously variable from 20 mμs to 12.5 ms in four ranges.

20 to100 mμs
100 to 500 mμs
.5 to 2.5 μs
2.5 to 12.5 μs

Note: Pulse width is limited to approximately 25% of the pulse to pulse spacing. Attempting to exceed this limitation will result in the output pulses occurring at a repetition rate that is a sub-multiple of the oscillator setting.

Main Pulses -

Pulse Amplitude
Positive - at least 40V
Negative - at least 45V

Output Impedance - 185 ohms

Output Decay Constant
(when terminated in 185Ω) - 750 μs

Rise and Fall Time - Less than 8 mμs.

Attenuation - 60 db in ½ db steps

Delay - A fixed delay of .14 us occurs between the sync. & pulse and the main pulse.

Power Requirements - 105 to 125 volts, 50-60 CPS, 650 watts maximum

Ventilation - Filtered, forced air.

Dimensions - 23 Wide, 23 High, 16 Deep

Weight - 115 lbs.

Accessories Included -

1 extension cable
1 five ft. output cable
1 termination, 185Ω
1 terminating resistor
1 instruction manual

OPERATING INSTRUCTIONS

Preliminary Instructions:

Cooling:
The Model B-5 Pulse Generator is cooled by filtered, forced air ventilation. The air filter must be kept clean enough to permit adequate circulation and the instrument must be placed so that the air intake is not blocked.

Limitation of Pulse Width:
The maximum pulse width is approximately 25% of the pulse to pulse spacing. Attempting to operate the instrument beyond this rating will result in an output repetition rate that is a sub-multiple of the oscillator frequency, and may cause damage to the EFP 60 tubes.

Impedance Matching:
To preserve the output waveform free from ringing and overshoot, it is imperative that the output cable be matched to the 185 ohm output and that the cable be terminated in its characteristic impedance. Furthermore, both outputs must be terminated in 185 ohms. For example, if only the positive output is being used, the negative output must be terminated at the instrument. The use of the 185 ohm termination supplied is suggested.

Function of Front Panel Controls and Connectors:

Oscillator:
Frequency Range - 8 position switch selects mode of operation, external or internal triggering, and repetition rate range for internal operation.
Frequency - Adjustment of grid return resistance to determine frequency of operation. For external triggering, this control adjusts the bias of the multivibrator for maximum trigger stability.
Ext. Trigger - BNC Coax Connector to trigger amplifier.
Sync. Out - BNC Coax Connector from trigger output amplifier.

Pulse Forming:
Pulse Width Range - Four-Position switch selects range of output pulse width.
Pulse Width Vernier - Potentiometer mounted concentric with range switch that adjusts grid return voltage to determine pulse width.

Pulse Amplifier:
Pulse Shape Adjust - Adjusts grid voltage for best output waveform.
Pos. Output - Type C Coax connector from positive output of amplifier.
Neg. Output - Type C Coax Connector from negative output of amplifier.

Attenuator:
10 db switch - 6 position switch controlling five 10 db attenuators.
Toggle Switches - 5 toggle switches controlling attenuators of $\frac{1}{2}$, 1, 2, 2, and 5, db each.

Power Supply:
On-Off Switch - Toggle switch controls main power to the unit
Fuse - $6\frac{1}{4}$ amp slo-blow fuse for main power input
Pilot - Green indicator lamp indicates when instrument is operating.

First Time Operation:

It is recommended that the instrument be placed into operation at a low repetition rate which facilitates synchronizing the oscilloscope and then increasing the frequency to the desired rate. The following procedure is recommended:

Turn the power switch to "OFF" and connect the line cord to a source of 117 V, 50/60 - cycle power. Set the controls as follows:

Freq. Range	10 to 100 KC
Freq.	CCW
Pulse Width Range	2.5 - 12.5 μs
Pulse Width Vernier	CW
Attenuator 10 db	0
½,1,2,2,5 db	out

Connect a synchroscope as follows:

Ext. trigger input to sync. output
Vert. input to Pos. output
and set
Sweep rate to 50 μs/centimeter
Vert. sensitivity to 20 V/c

Turn on the power switch and after about one minute, adjust the synchroscope trigger sensitivity to obtain a stable trace. The pulse width can then be reduced and the frequency changed to any value desired. With many synchroscopes, synchronization is difficult at repetition rates approaching 10 MC. If difficulty is encountered, refer to the instruction book for your model scope.

CIRCUIT DESCRIPTION

Block Diagram:

The block diagram shows the interconnections between the chassis and the functional parts within the chassis of the pulse generator with the exception of the power supply and power wiring.

Oscillator Chassis:

Trigger Amplifier - The trigger amplifier amplifies the incoming external trigger and applies it to the screen grid of the multivibrator oscillator, which for external operation, is a monostable multivibrator.

Oscillator - A free running multivibrator. For external triggering, one tube is biased off and the circuit becomes a monostable multivibrator that amplifies and shapes the trigger from the trigger amplifier.

Shaper Amplifier - Amplifies and shapes the square wave from the multivibrator into positive pulses for application to the sync. amplifier.

Sync. Amplifier - Amplifies the positive pulses from the shaper amplifier into a positive pulse that drives the sync. out jack and a negative pulse that drives the trigger former stage.

Trigger Former - A monostable regenerative circuit that generates positive triggers of about 15 millimicrosecond width when triggered from the sync. amplifier.

Delay Chassis:

Delay line - 40 ft. of R µs G-114/U coax cable that delays the output signal approximately .14 microseconds from the sync. output.

Pulse Forming Chassis:

Pulse Regenerative Circuit - Generates an output pulse of variable width when triggered.

Buffer Amplifier - Inverts, amplifies and shapes the output of the pulse regenerative circuit and drives the output amplifier.

Output Amplifier:

The output amplifier, amplifies the input and splits the the signal into positive and negative pulses.

Attenuator:

The attenuator can be connected to either the positive or negative output of the output amplifier and will attenuate the signal in increments of ½ db up to a total of 60 db.

A more detailed description of the circuits is included for each of the plug-in components in the section of this instruction book devoted to the specific chassis.

MAINTENANCE

Air Filter:

The B-5 Pulse Generator is cooled by filtered forced air. The air filter is washable expanded aluminum foil coated with adhesive. If it gets too dirty, it will restrict the flow of cooling air and may cause damage to the instrument from overheating.

To clean the air filter, the following instructions are given by the manufacturer:

"(1) If grease or dirt load is light, remove filter from installation and flush dirt or grease out of filter with a stream of hot water or steam.

(2) If load is too heavy for treatment in (1) above, prepare mild soap or detergent solution in pan or sink deep enough to cover filter when laid flat. Agitate filter up and down in this solution until grease or dirt is loosened and carried off filter.

(3) Rinse filter and let dry.

(4) Dip or spray filter with fresh Filter Coat, or other approved adhesive. Filter Coat is available from the local representative of RESEARCH PRODUCTS CORP., in the one-pint Handi-Koter with spray attachment or one-gallon and five-gallon containers."

Fan Motor:

The fan motor bearings require oiling every few months. Use a good grade of light machine oil and apply only a drop or two every six months.

Trouble Shooting

The maintenance of each sub-chassis of the B-5 Pulse Generator is described in detail in its own section of this instruction book. Therefore, at this time, we will confine ourselves to determining the defective unit.

If the instrument fails to operate at all, including the fan and pilot light, check the source of power and make certain that the power cord plug is firmly in place. Then check the fuse on the front of the Model 1013 power supply.

If the pilot lights, but the fan fails to operate, check to make sure that the fan is plugged into its outlet in the back of the instrument.

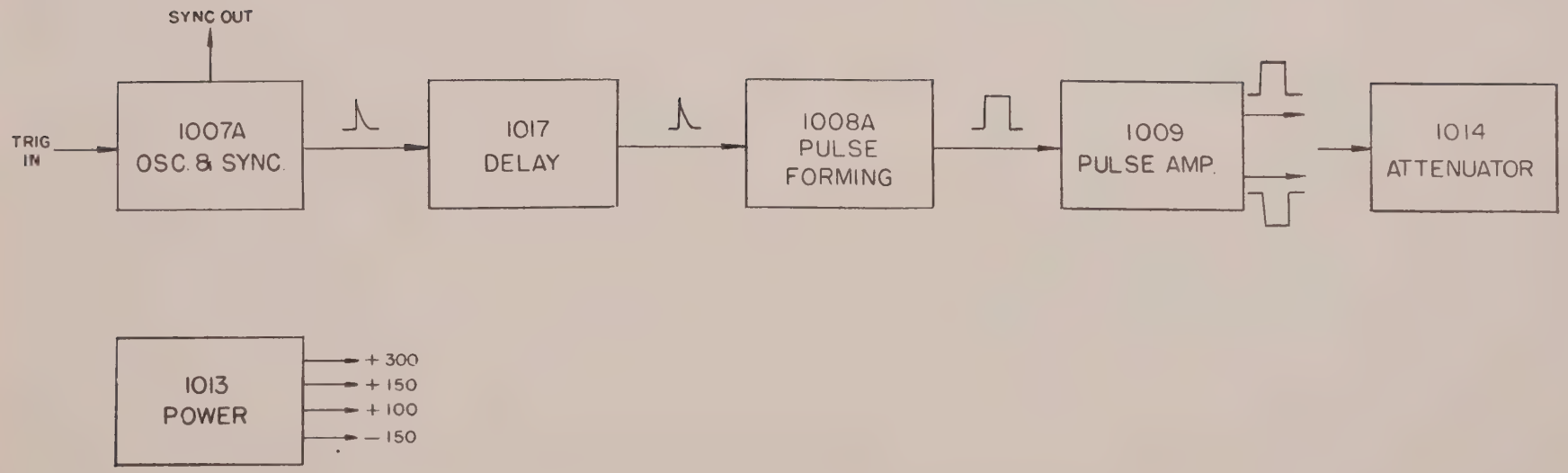
An early check to make is the power supply voltages. Remove the power supply and connect it to the instrument with the extension cable provided. The voltages can then be measured at the output plug. The voltages should read -150, +100, +150 and +300. For plug wiring, refer to the drawing in power supply section.

If the power supply voltages are correct, a few simple checks will isolate the defective unit.

If there is no sync. out pulse from the oscillator unit, the unit is defective. If, however, the oscillator seems to be operating correctly, synchronize an oscilloscope from the sync. output and trace back from the output to find the devective unit. If there is no output from the attenuator, check the output from the output amplifier. A signal here would indicate a defective attenuator or connecting cable.

If there is no output from the amplifier, check the output of the pulse forming unit. This can be done by opening the back door of the cabinet and disconnecting the cable to the output amplifier. The output should then be a positive pulse of approximately 30 volts amplitude. (CAUTION: There is a D.C. Voltage on this jack.) If there is no output from the pulse forming unit, a check should be made to determine that the unit is receiving a trigger from the delay line. This can be done by disconnecting the delay line and observing the waveform. It should have an amplitude of approximately 12 volts positive.

The lack of output could be caused by only two things, an open delay line, or a defective oscillator chassis. A check of the output of the oscillator will eliminate one of these units.



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BLOCK DIAGRAM
10-30-58 B5-100A
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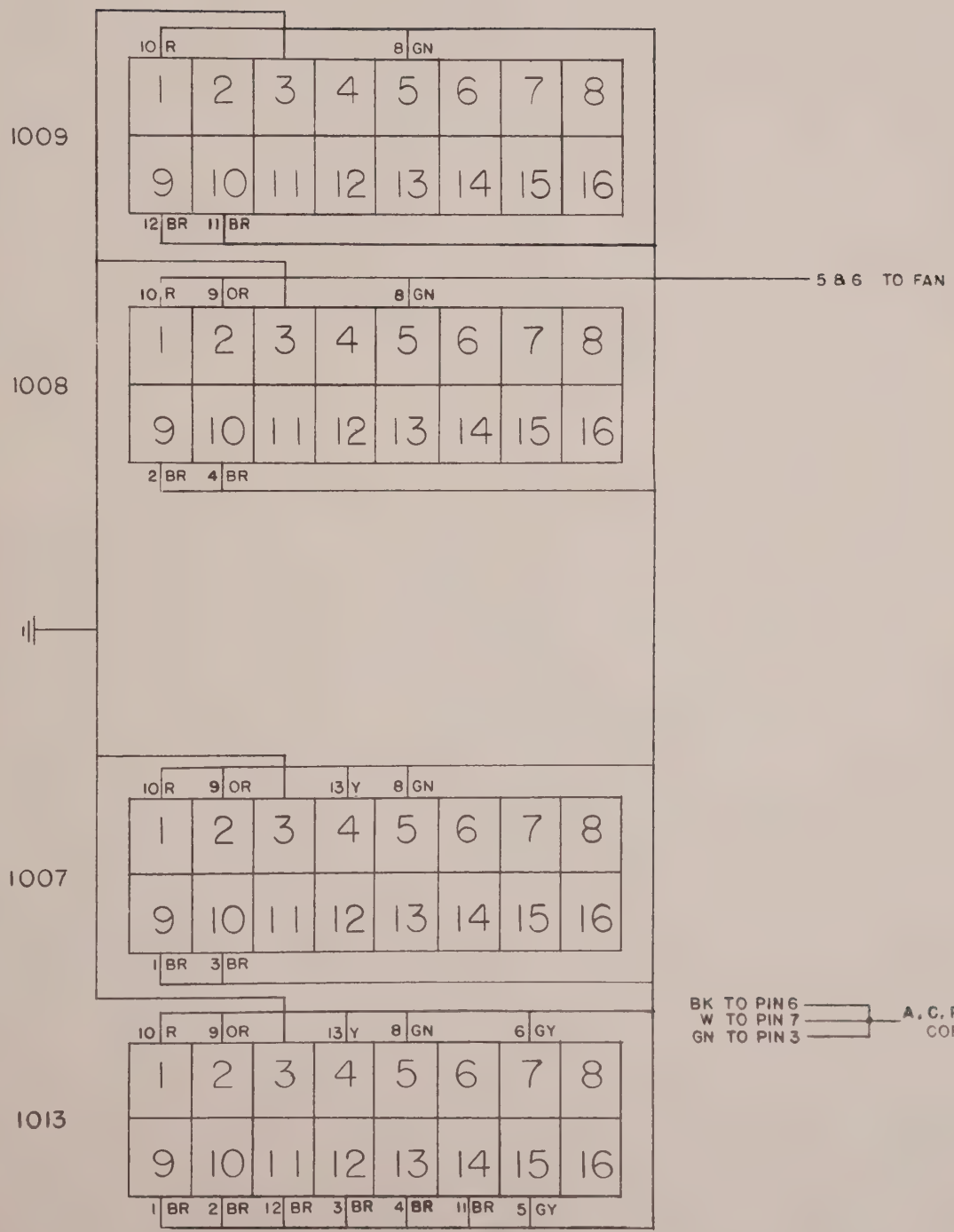


RUTHERFORD ELECTRONICS CO.

8-29-57

B5-101A

APP. BY. Clapp SER. NO. _____

INTERCONNECTING WIRING

INSTRUCTION BOOK

10 MC. OSCILLATOR
MODEL 1007A

Serial No. 182

Price $2.00

Rutherford ELECTRONICS CO.
8944 LINDBLADE ST., CULVER CITY, CALIF
TExas 0-7393

For use as a trigger shaper, a variable negative bias is applied to the grid of V12 in such a manner that the multivibrator becomes monostable. The repetition rate vernier now serves as a trigger sensitivity control. The external trigger is applied to the screen grid of the normally conducting tube, V11, by the external trigger amplifier and is a negative pulse.

Shaping Amplifier

The plate load of the shaping amplifier V13 is an 8.2 μh inductor which differentiates the output of the multivibrator in to pulses to apply to the sync. amplifier. The 8.2 μh coil is resonant at about 10 mc and causes the output amplitude of the shaping amplifier to increase as the frequency is raised, providing additional drive to V14 under the severest operating conditions.

Sync. Amplifier

The Sync. Amplifier, V14, is an EFP60, secondary emission pentode with its grid biased below cutoff. The positive pulses from the shaper drive the grid into the conducting region and are, therefore, amplified. The negative pulses do not, of course, get thru this amplifier. For each positive pulse on the grid, there will be an amplified positive pulse at the dynode, pin 5, and an amplified negative pulse at the plate, pin 6. The positive pulse is used as the Sync. Out while the negative pulse is used to trigger the trigger former.

Trigger Former

The Trigger Former uses an EFP60 tube V15, is a monostable regenerative circuit. The width of the pulse is determined by the time constant of the plate to cathode feedback capacitors C151 and C152. Positive feedback is also applied from the dynode to grid by capacitor C150, however, the time constant of this coupling chain is longer than that of the plate to cathode chain and, therefore, has no effect on the pulse width.

To understand the circuit operation, assume the circuit is in the quiescent state. The grid return is to a negative voltage sufficient to keep the tube cut off, therefore, the plate will be at the plate supply voltage, 300V, and the dynode will be at the dynode supply voltage, 100V. A negative pulse is applied to the plate, and through the timing capacitors C151 and C152 to the cathode. When the cathode is driven negative, anode current flows to the dynode and dynode current flows to the cathode; the anode current is is much larger than the dynode-cathode current; therefore the anode goes negative and the dynode goes positive. The negative pulse on the anode aids the trigger as does the positive pulse on the dynode that is coupled to the grid. These combined feedbacks cause the circuit to switch to its unstable state and will remain in this state as long as the grid to cathode voltage remains above cutoff. During the conducting period, the cathode voltage is rising and the grid voltage is dropping, as the charge leaks off of the timing and coupling capacitors. At the time that the tube starts to cut-off, the anode starts to rise and the dynode drops, causing the tube to cut-off completely. The resulting positive pulse at the dynode is used as the trigger out.

MAINTENANCE

Troubles are usually caused by tube failure, and can be corrected by finding the defective tubes and replacing them. Sometimes a tube failure will burn up resistors or other components in the circuit and these will have to be replaced. Often the damaged components can be found by visual inspection, but others may require more rigorous testing. The usual failure is a change in value of resistors. One way to find bad tubes is to replace all tubes in a suspected circuit; then, if the trouble is corrected, replace the old tubes one at a time until the bad ones are found.

Oscillator Adjustments:

Before making any other adjustments the timing condensers C110 and C120 should be adjusted as described under 10 mega cycle adjust.

Ten Megacycle Adjust:

The trimmer condensers, C110 and C120, in the two timing chains should be adjusted successively at the highest range in such a way that the repetition rate with the vernier at maximum is 10 mc and until the corresponding waveform is nearly symmetrical.

Set the frequency range switch to the 10 mc position and the frequency vernier to its clockwise position. Connect the low capacitance probe from the synchroscope to the plate, pin 6, of V12 and adjust C110 and C120 alternately until the waveform is symmetrical and the frequency is 10 mc. Next, move the probe to the plate of V13, pin 6, and readjust C110 until the frequency is 10 mc. This procedure will correct for any capacity effects of the scope probe.

Frequency Adjustments

The maximum frequency of each of the lower ranges is adjusted by a variable resistor, R123 through R128, located on the rear of the unit. These resistors are labeled the same as the range marking for the range switch and should be adjusted with the vernier in the clockwise position.

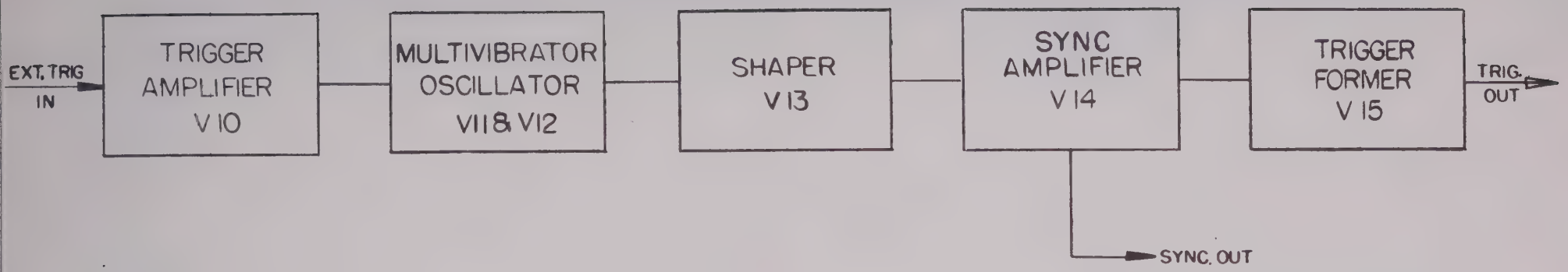
With the synchroscope still connected to the plate, pin 6, of V13 and the frequency vernier in the clockwise position, set the range switch to the 100-1000 kc position and adjust the 100-1000 kc resistor, R123, until the frequency is 1 mc. Next, set the range switch to the 10-100 kc position and adjust the 10-100 kc resistor, R124, until the frequency is 100 kc. Continue in a like manner for the remainder of the ranges.

Sync. Amplifier Adjustments

The only adjustment for the Sync. Amplifier is a bias adjustment, R143. This adjustment should be made so that only the positive pulses from the shaper amplifier are amplified by the Sync. Amplifier but so that none of the negative pulses or noise between positive pulses is permitted past the Sync. Amplifier. This adjustment should be made at a low regular rate and then checked throughout the ranges.

Trigger Former Adjustments

The width of the output pulse is adjusted by C151, a ceramic trimmer. This pulse width should be adjusted to not exceed 15 millimicroseconds.



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BLOCK DIAGRAM

9-15-58 1007-105

DR. Owen APP. WJS

ABBREVIATIONS

CER.	CERAMIC	UH	MICROHENRY OR 10^{-6} HENRY
COMP.	COMPOSITION	USEC.	MICROSECONDS
EMC	ELECTROLYTIC, METAL CASED	PF	PICOFARAD OR 10^{-12} FARAD
GMV	GUARANTEED MINIMUM VALUE	PMF	PAPER, METAL CASED
H	HENRY	PREC.	PRECISION
K	KILOHM OR 10^{3} OHMS	PT	PAPER TUBULAR
MEG	MEGOHM OR 10^{6} OHMS	S.MICA	SILVERED MICA
MF	MICROFARAD OR 10^{-6} FARAD	V	WORKING VOLTS DC
M.F.	METAL FILM	VAR.	VARIABLE
MH	MILLIHENRY OR 10^{-3} HENRY	W	WATT
MP	METALLIZED PAPER	WW	WIRE WOUND

MODEL 1007A 10 MC. OSCILLATOR

CAPACITORS

C10	10MF	450V	FIXED	EMC	-20+50%
C11	.01MF	500V	FIXED	CER.	GMV
C12	.01MF	500V	FIXED	CER.	GMV
C13	10MF	450V	FIXED	EMC.	-20+50%
C14	.01MF	500V	FIXED	CER.	GMV
C100	100PF	500V	FIXED	CER.	10%
C110	7-45PF	500V	VAR.	CER	
C111	220PF	500V	FIXED	S.MICA	5%
C112	3300PF	500V	FIXED	S.MICA	5%
C113	680PF	500V	FIXED	S.MICA	5%
C114	.0068MF	500V	FIXED	S.MICA	5%
C115	.068MF	200V	FIXED	MYLAR	5%
C116	.68MF	200V	FIXED	MYLAR	3%
C120	7-45PF	500V	VAR.	CER	
C121	.01MF	500V	FIXED	CER.	GMV
C122	220PF	500V	FIXED	S.MICA	5%
C123	3300PF	500V	FIXED	S.MICA	5%
C124	680PF	500V	FIXED	S.MICA	5%
C125	.0068MF	500V	FIXED	MICA	5%
C126	.068MF	200V	FIXED	MYLAR	5%
C127	.68MF	200V	FIXED	MYLAR	5%
C128	.01MF	500V	FIXED	CER.	GMV
C140	.01MF	500V	FIXED	CER.	GMV
C141	.001MF	500V	FIXED	CER.	10%
C142	.01MF	500V	FIXED	CER.	GMV
C150	33PF	500V	FIXED	S.MICA	5%
C151	7-45PF	500V	VAR.	CER.	
C152	33PF	500V	FIXED	S.MICA	5%
C153	.01MF	500V	FIXED	CER.	GMV
C154	.01MF	500V	FIXED	CER.	GMV
C155	.01MF	500V	FIXED	CER.	GMV

CHOKES

L10	500UH	FIXED	20%
L11	500UH	FIXED	20%
L12	500UH	FIXED	20%

CHOKES (Cont.)

L110	1.2μH	FIXED	20%
L111	1.2μH	FIXED	20%
L120	1.2μH	FIXED	20%
L121	1.2μH	FIXED	20%
L130	8.2μH	FIXED	20%

DIODE

X120	6 VOLT	ZENAR DIODE	HOFFMAN	GZ5

ELECTRON TUBES

V10	6CL6	TRIGGER AMPLIFIER
V11	6CL6	OSCILLATOR
V12	6CL6	OSCILLATOR
V13	6CL6	SHAPING AMP.
V14	EFP60	SYNC. AMPLIFIER
V15	EFP60	TRIG. OUTPUT

RESISTORS

R100	470 OHM	½W	FIXED	COMP.	10%
R101	10K	½W	FIXED	COMP.	10%
R102	180K	½W	FIXED	COMP.	10%
R110	360 OHM	3W	FIXED	M.F.	5%
R111	390 OHM	½W	FIXED	COMP.	10%
R112A	1M	½W	VAR.	COMP.	20%
R112B	25K	½W	VAR.	COMP.	20%
R112C	25K	½W	VAR.	COMP.	20%
R112D	1M	½W	VAR.	COMP.	20%
R113	1.5K	½W	FIXED	COMP.	10%
R114	82K	½W	FIXED	COMP.	10%
R120	360 OHM	3W	FIXED	M.F.	5%
R121	390 OHM	½W	FIXED	COMP.	10%
R122	120K	½W	FIXED	COMP.	10%
R123	5K	½W	VAR.	COMP.	20%
R124	5K	½W	VAR.	COMP.	20%
R125	250K	½W	VAR.	COMP.	20%
R126	250K	½W	VAR.	COMP.	20%
R127	250K	½W	VAR.	COMP.	20%
R128	250K	½W	VAR.	COMP.	20%
R130	33K	2W	FIXED	COMP.	10%
R140	470 OHM	½W	FIXED	COMP.	10%
R141	330 OHM	½W	FIXED	COMP.	10%
R142	10K	2W	FIXED	COMP.	10%
R143	5K		VAR.	COMP.	
R144	470 OHM	½W	FIXED	COMP.	10%

RESISTORS (Cont.)

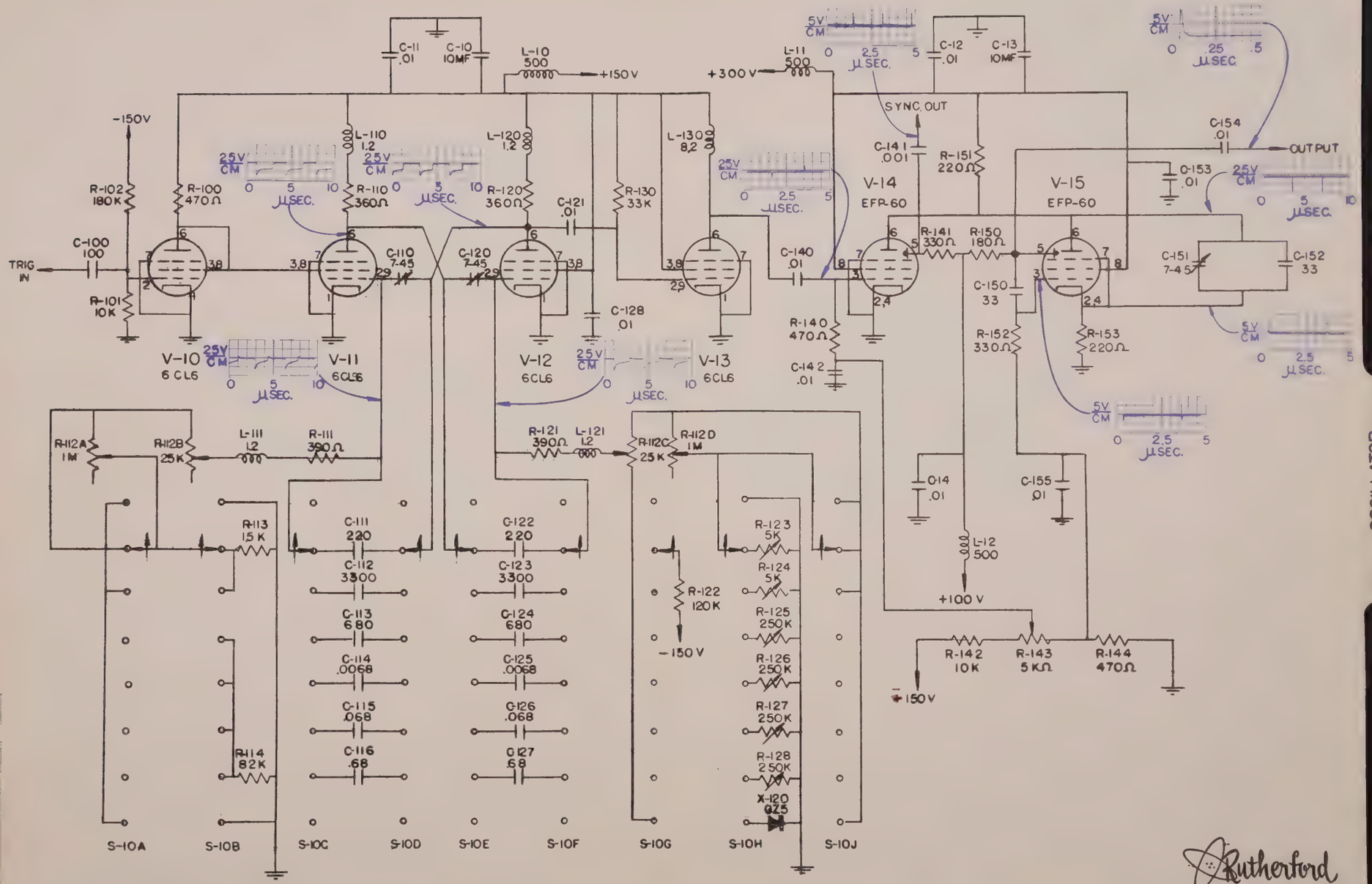
R150	180 OHM	½W	FIXED	COMP.	10%
R151	220 OHM	2W	FIXED	COMP.	10%
R152	330 OHM	½W	FIXED	COMP.	10%
R153	220 OHM	½W	FIXED	COMP.	10%

SWITCH

S10	7 POLE	8 POSITION	ROTARY SWITCH	1007A-A-503

WAVEFORMS

These waveforms were reproduced from photographs taken with a Tektronix type 517A oscilloscope.

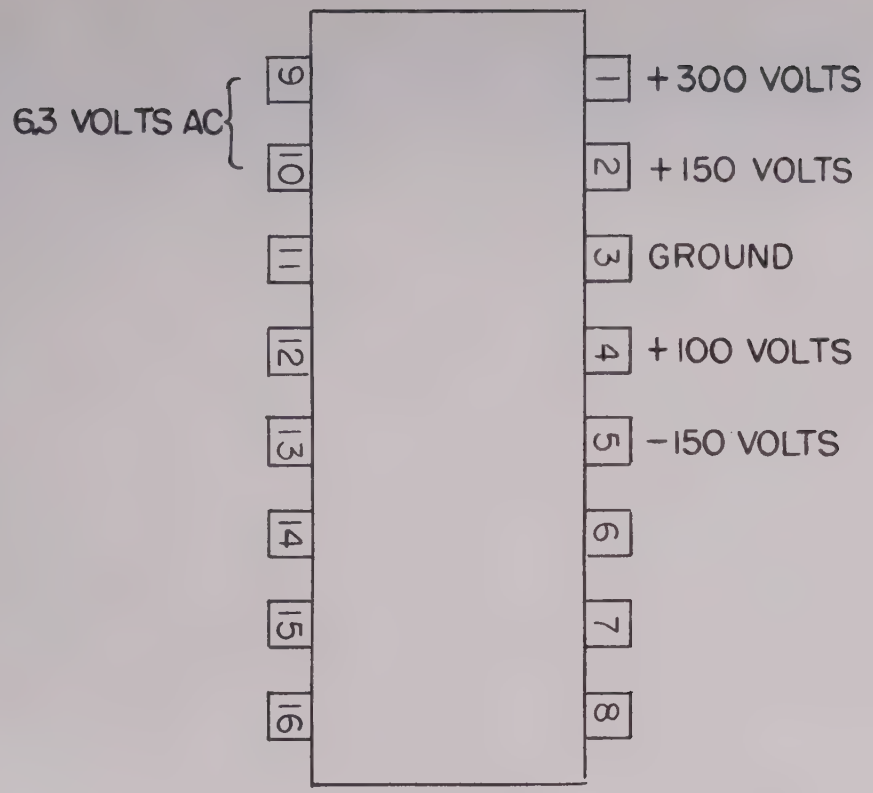


NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL INDUCTANCES IN MICROHENRYS.
2. ALL CAPACITOR VALUES LESS THAN ONE (1) ARE IN MICROFARADS, THOSE GREATER THAN ONE (1) ARE IN MICROMICROFARADS.

Rutherford

OSCILLATOR
8-17-58 1007A-104
DR. OLSEN APP. WJC

OSCILLATOR



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PLUG DIAGRAM

9-15-58 1007-103

DR. Olson APP. WFC

INSTRUCTION BOOK

PULSE FORMING UNIT
MODEL 1008B

Serial No. 182

Price $2.00

Rutherford ELECTRONICS CO.
8944 LINDBLADE ST., CULVER CITY, CALIF
TExas 0-7393

MODEL 1008B
PULSE FORMING UNIT

NERAL DESCRIPTION

The Model 1008B Pulse Forming Unit is signed to produce a variable width pulse repetition rates up to 10 megacycles en triggered from a suitable source. The lse width can be varied from 20 milli-croseconds to about 25% of the pulse to lse spacing or a maximum of 12.5 micro-conds.

ECIFICATIONS

Operating Frequency - 0 to 10 mc
Input Trigger
  Amplitude - 10V
  Polarity - Positive
  Width - Not wider than 20 mus
  Input Impedance - 3.7 k
Pulse Width - 20 mus to 12½ us in four ranges
  20 mus to 100 mus
  100 mus to 500 mus
  .5 us to 2.5 us
  2.5 us to 12.5 us
Output Pulse
  Amplitude - 10 volts when terminated in 185 ohms
  Polarity - Positive
  Rise Time - 10 mus
  Width - 20 mus to 12.5 us
  Impedance - 185 ohms
Power Required
  300 VDC @ 40 ma
  150 VDC @ 140 ma
  -150 VDC @ 20 ma
  6.3 VAC @ 2.1 amps

PERATING INSTRUCTIONS

Cooling:
The Model 1008B will cool itself by convection, if operated in a location with unrestricted air flow and normal temperatures. If however, the unit is mounted in a rack or cabinet with other equipment, forced ventilation will probably be required. Special care should be executed to keep the EFP 60 tubes cool as excessive temperature will result in the emitting material on the dynode transferring to other electrodes.

Limitations:
The pulse width should not be adjusted wider than about 25% of the pulse to pulse spacing of the trigger. Failure to observe this precaution will result in malfunction of the circuit.

Impedance Matching:
The output of this unit has a characteristic impedance of 185 ohms. It is imperative that the output be matched with this impedance for proper operation.

Function of Controls:

Pulse Width Range - Four position switch selects range of output pulse width.

Pulse Width Vernier- Potentiometer mounted concentric with range switch that adjusts value of grid return resistor to determine pulse width.

Trigger Input - Type C Jack to amplifier grid.

Pulse Output - Type C Jack from output of buffer amplifier.

First Time Operation:
Connect the unit to the required voltages (the connections are shown in the power connector drawing) and after about a minute warm up time, apply a 10 kc trigger to the trigger input jack. The pulse width can then be set to any value desired and observed at the pulse output jack. After setting the pulse width, the frequency can be adjusted to any desired value up to 10 megacycles so long as the duty factor limitation is not exceeded.

CIRCUIT DESCRIPTION

Block Diagram:
The block diagram shows the functional parts of the unit.

Trigger Amplifier:
The trigger amplifier, V10, amplifies and inverts the trigger pulse. This stage is coupled through C110 to the pulse forming stage cathode.

The 15 mus wide trigger is coupled to the grid, pin 3, of the tube, V10, through the coupling condenser, C100. The positive pulse on the grid causes an increase of cathode current. The electrons from the cathode are formed into a beam by the suppressor grid and directed to the dynode. Upon striking the dynode, each electron releases many electrons from the secondary emitting coating, which are attracted to the plate. The result is that two stages of amplification are accomplished within one tube.

The negative signal from the plate is

coupled to the cathode of the pulse forming stage by C110.

Pulse Forming Stage:

The pulse forming stage is a regenerative circuit that is monostable. (That is, like a single shot multivibrator). The length of time that the circuit remains in its unstable state is determined by the time constant of the grid circuit.

The regenerative circuit is designed around a single tube, V11, of the secondary emission type, EFP60. Use is made of the fact that a positive grid signal yields a positive amplified signal at the dynode, permitting positive feedback by coupling the dynode to the grid. In this circuit, the coupling is by C112 for the narrowest pulse width range. For the wider ranges, additional condensers are connected in parallel with C112 to change the time constant of the grid circuit. To provide for variable pulse width, the grid return resistor is made variable.

To understand the circuit operation, assume the circuit is in the quiescent state. The grid return is to a negative voltage sufficient to keep the tube cut off; therefore the plate will be at the plate supply voltage, 300V, and the dynode will be at the dynode supply voltage, 150V. A negative trigger is applied to the cathode. When the cathode is driven negative, anode current flows to the dynode and dynode current flows to the cathode; the anode current is much greater than the dynode-cathode current; therefore, the anode goes negative and the dynode goes positive. The positive pulse on the dynode aids the trigger and the circuit switches to its unstable state and will remain in this state as long as the grid remains above cut-off. The grid, however, is becoming more negative as the charge leaks off the timing condenser thru the grid return resistor. At the time that the tube starts to cut-off, the dynode drops, causing the tube to cut-off completely. The output from the anode is a negative pulse and is fed to pin 2,9 of V15 and V16.

Buffer Amplifier:

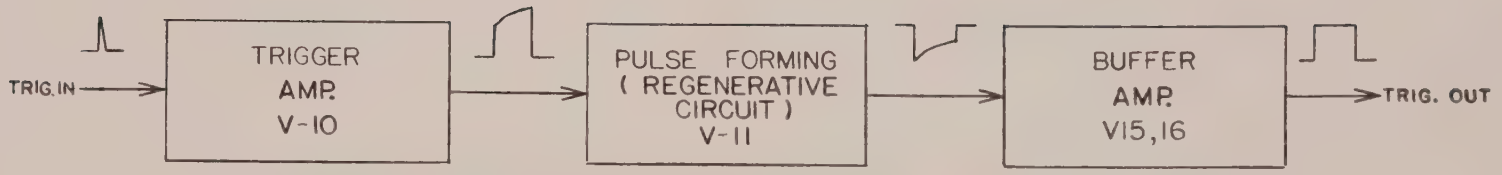
The buffer amplifier consists of V15 and V16, two 6CL6 tubes in parallel. The grids, pin 2 and 9, are at ground potential, thus having the tubes fully conducting. The negative output pulse from the plate of V11 drives the buffer amplifier from zero bias to cut off. This produces a positive going pulse across R151, which is obtainable on a Type "C" coax connector at the rear of the chassis. Pulse amplitude is about 10 volts and the rise time approximately 10 millimicroseconds. The output is directly connected to pin 6 of V15 and V16 therefore being at the plate potential of 150 volts DC.

MAINTENANCE

Troubles are usually caused by tube failure, and can be corrected by finding the defective tubes and replacing them. Sometimes a tube failure will burn up resistors or other components in the circuit, and these will have to be replaced. Often the damaged components can be found by visual inspection, but others may require more rigorous testing. The usual failure is a change in value of a resistor. One way to find bad tubes is to replace the old tubes one at a time until the bad ones are found.

Pulse Width Adjustments:

To adjust the minimum width range, it may be necessary to adjust the timing condenser C112. Proceed as follows: Set the pulse width range switch to the 20 – 100 mus. range and the vernier to its clockwise position. Adjust C112 until the pulse width is 100 mus. Then by turning the pulse width vernier control counterclockwise, the pulse width should be about 20 mus. The value of C112 must be large enough to insure proper regenerative action. If it is impossible to reduce the pulse width to 20 mus. by turning R115 counterclockwise, or if the circuit ceases to operate at this position, it may probably be necessary to replace V11.



Rutherford

BLOCK DIAGRAM
9-23-58 1008A-102B
DR. Gilbert APP. J.R.J.

ABBREVIATIONS

CER.	CERAMIC	UH	MICROHENRY OR 10^{-6} HENRY
COMP.	COMPOSITION	USEC.	MICROSECONDS
EMC	ELECTROLYTIC, METAL CASED	PF	PICOFARAD OR 10^{-12} FARAD
GMV	GUARANTEED MINIMUM VALUE	PMF	PAPER, METAL CASED
H	HENRY	PREC.	PRECISION
K	KILOHM OR 10^{3} OHMS	PT	PAPER TUBULAR
MEG	MEGOHM OR 10^{6} OHMS	S.MICA	SILVERED MICA
MF	MICROFARAD OR 10^{-6} FARAD	V	WORKING VOLTS DC
M.F.	METAL FILM	VAR.	VARIABLE
MH	MILLIHENRY OR 10^{-3} HENRY	W	WATT
MP	METALLIZED PAPER	WW	WIRE WOUND

MODEL 1008B PULSE FORMING

CAPACITORS

C10	10MF	450V	FIXED	EMC	-20+50%
C13	2MF	450V	FIXED	EMC	-20+50%
C14	.01MF	500V	FIXED	CER.	GMV
C15	10MF	450V	FIXED	EMC	-20+50%
C16	.01MF	500V	FIXED	CER	GMV
C100	.01MF	500V	FIXED	CER.	GMV
C101	.01MF	500V	FIXED	CER.	GMV
C102	.01MF	500V	FIXED	CER.	GMV
C110	.01MF	500V	FIXED	CER.	GMV
C111	.01MF	500V	FIXED	CER.	GMV
C112	7-45MMF	500V	VAR	CER.	
C113	3900PF	500V	FIXED	S.MICA	5%
C114	680 PF	500V	FIXED	S.MICA	5%
C115	180PF	500V	FIXED	S.MICA	5%
C116	5MF	150V	FIXED	EMC	-20+50%
C117	.01MF	500V	FIXED	CER.	GMV
C118	5MF	150V	FIXED	EMC.	-20+50%
C150	.01MF	500V	FIXED	CER.	GMV

CHOKES

L10	500UH	FIXED	20%
L11	500UH	FIXED	20%
L12	500UH	FIXED	20%
L110	.15UH	FIXED	20%
L111	2.7UH	FIXED	20%
L112	2.7UH	FIXED	20%
L150	.24UH	FIXED	20%

DIODES

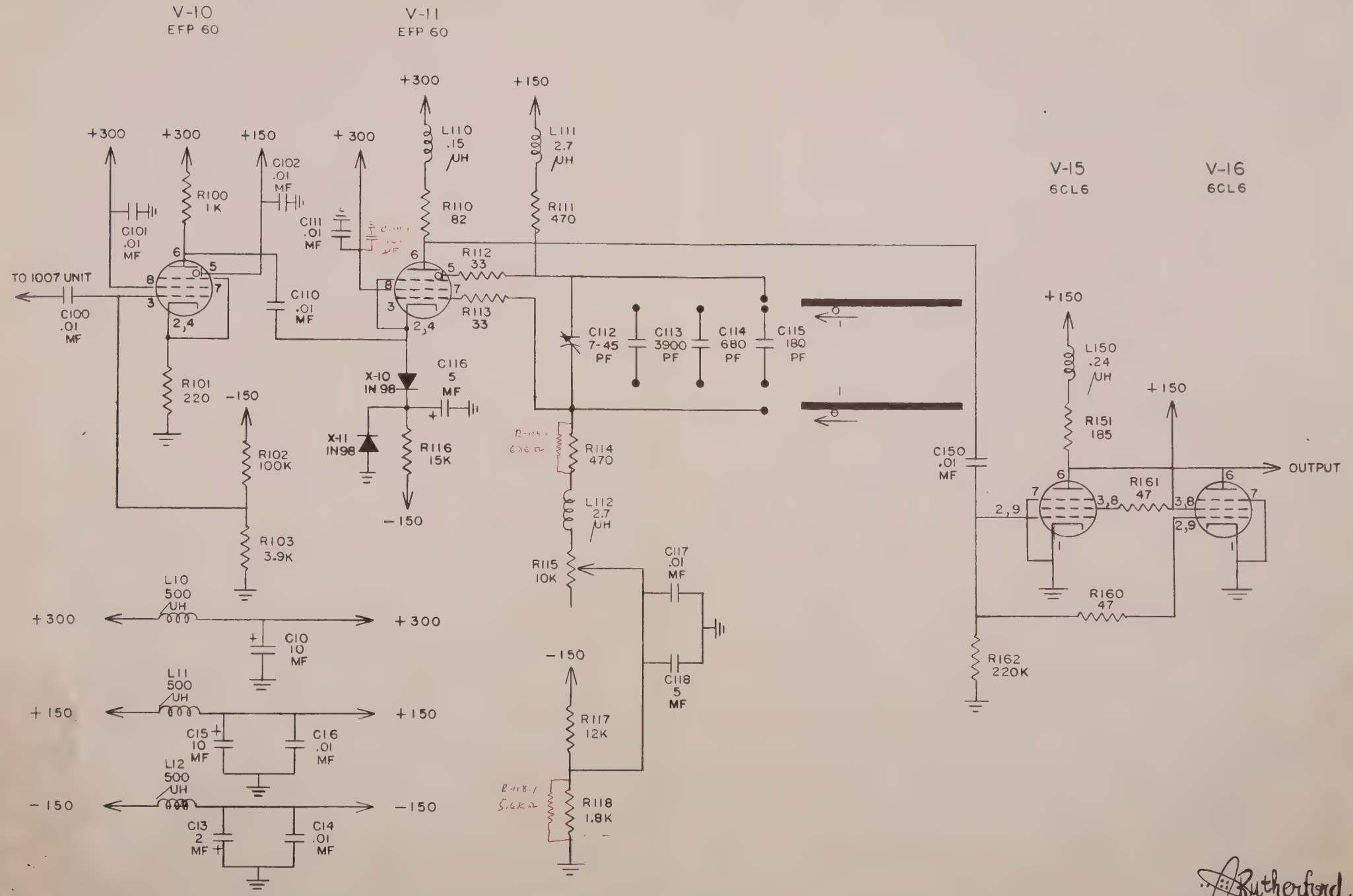
X10	1N98
X11	1N98

ELECTRON TUBES

V10	EFP60	TRIGGER AMPLIFIER
V11	EFP60	PULSE FORMING
V15	6CL6	BUFFER AMPLIFIER
V16	6CL6	BUFFER AMPLIFIER

RESISTORS

R100	1K	½W	FIXED	COMP.	10%
R101	220 OHM	½W	FIXED	COMP.	10%
R102	100K	½W	FIXED	COMP.	10%
R103	3.9K	½W	FIXED	COMP.	10%
R110	82 OHM	½W	FIXED	COMP.	10%
R111	470 OHM	½W	FIXED	COMP.	10%
R112	33 OHM	½W	FIXED	COMP.	10%
R113	33 OHM	½W	FIXED	COMP.	10%
R114	470 OHM	½W	FIXED	COMP.	10%
R115	10K	.2W	VAR.	COMP.	10%
R116	15K	2W	FIXED	COMP.	10%
R117	12K	2W	FIXED	COMP.	10%
R118	1.8K	½W	FIXED	COMP.	10%
R151	185 OHM	5W	FIXED	PREC.	1%
R160	47 OHM	½W	FIXED	COMP.	10%
R161	47 OHM	½W	FIXED	COMP.	10%
R162	220K	½W	FIXED	COMP.	10%



PULSE FORMING SCHEM.

Rutherford
PULSE FORMING
1.7.59. 1008B-104
DR. V.S. APP.

INSTRUCTION BOOK

PULSE AMPLIFIER
MODEL 1009

Serial No. 184

Price $2.00

Rutherford ELECTRONICS CO.
8944 LINDBLADE ST., CULVER CITY, CALIF
TExas 0-7393

MODEL 1009

GENERAL DESCRIPTION

The Model 1009 Pulse Amplifier is a wide band amplifier of the distributed type employing six secondary emission tubes, type EFP60. The tubes are biased at cutoff and driven by a positive pulse on the grid line. An amplified positive pulse is available from the dynode line and a negative pulse is available from the plate line.

This amplifier is not linear and must be operated with the grids driven from cutoff to saturation, zero volts, for proper output wave form.

SPECIFICATIONS

Input Pulse - Positive
  Amplitude - 6 V min. 20 V Mx.
Output Pulse - Positive
  Amplitude - 40 volts
  Rise Time - less than 8 mμs
Output Pulse - Negative
  Amplitude - 45 volts
  Rise Time - Less than 8 mμs

Power Requirements
  +300 Volts @ 150 ma
  -150 Volts @ 1 ma
  6.3 VDC @ 3.7 amps

OPERATING INSTRUCTIONS:

Cooling

The Model 1009 amplifier will cool itself by convection when operated in a location with unrestricted airflow and normal temperatures. If, however, the unit is mounted in a cabinet or rack with other equipment or operated in limited space, it will be necessary to provide forced air ventilation. Special care should be exercised to keep the EFP60 tubes cool as excessive temperature will result in the emitting material on the dynode transferring to the other electrodes.

Impedance Matching

The input and outputs of this unit have characteristic impedances of 185 ohms. It is imperative that the input and both outputs be matched with this impedance for proper operation.

Function of Controls

Pulse shape control - Potentiometer that provides vernier control of the grid bias from the front panel for optimum pulse shape.

Output - Pos. - Type C jack connected to the dynode line of the amplifier

Output - Neg. - Type C jack connected to the plate line of the amplifier

Input - Type C jack at the rear of the chassis, connected to the grid line of the amplifier.

OPERATING INSTRUCTIONS (Continued)

Function of Controls (Cont)

Dynode Voltage Adjustment - Potentiometer that adjusts the voltage of the dynode power supply.

Bias Adjust - Potentiometer that adjusts the grid bias for optimum operation.

First Time Operation

Connect the unit to the required voltages, (The connections are shown in the power connector drawing) and after a minute's time connect a positive pulse to the input jack at the rear of the chassis. Terminate both outputs in 185 ohms and connect a synchroscope to the positive output. Set the pulse shape control in its mid-position and with a screwdriver adjust the bias control for the best waveshape. It is possible that there will be no output when the unit is first turned on. Advancing the bias adjust potentiometer will put the unit into operation.

CIRCUIT DESCRIPTION

The circuitry of the Model 1009 consists of two parts; the amplifier and an auxiliary regulator.

The amplifier is a six tube distributed amplifier using EFP60 secondary emission tubes. The tubes are biased at cut-off and hence draw no current except during the time a pulse is being amplified. This feature increases the circuit efficiency and keeps the power supply drain to a minimum. A positive pulse on the grid line overcomes the bias and drives the grids to zero volts with respect to the cathode.

Cathode current flows from the dynode, and by secondary emission plate current flows from the plate to the dynode. Since the plate current is several times the cathode current, the dynode current approximates the plate current. The transfer of electrons from the dynode to the plate will cause the plate to become negative while the dynode becomes positive. Hence, for a positive grid signal an amplified positive signal appears on the dynode line and an amplified negative signal appears on the plate line.

The grid bias is adjustable so that it can be set at the proper level for the top of the pulse to be at zero volts.

The dynode voltage is made adjustable and is adjusted for maximum amplitude on the dynode line. This adjustment is effected by an auxiliary regulator consisting of V-10, V-11, and V-12. Shunt tube regulation is used because the current is negative in this regulator. The voltage on the output bus is divided down by the divider R-103, R-102, and R-101 with reference to the -150 volts. The output of the divider is compared to the grounded cathode of V-10A and the amplified error signal is DC coupled to the grid of V-10B and amplified further. Finally, the output of V-10B is DC coupled to the grids of the shunt tubes V-11 and V-12. The shunt tubes change their plate resistance with a change in grid resistance in such a manner as to maintain the voltage on the output bus constant.

CIRCUIT DESCRIPTION (Continued)

If the voltage on the bus tends to rise as it will when the dynodes of the amplifier start to draw current, this increase in voltage is amplified by V-10A and V-10B and decreases the bias on the shunt tubes. The resistance of the shunt tubes is, therefore, lowered and they draw more current lowering the voltage on the bus to the predetermined value.

The output voltage is made variable by making the voltage divider variable by using a potentiometer, R-102, as one of the resistors. Condensers C-100, C-101, and C-102 increase the high frequency gain of the amplifiers and thereby reduce ripple caused by load changes.

MAINTENANCE

Troubles are usually caused by tube failure, and can be corrected by finding the defective tubes and replacing them. Sometimes a tube failure will burn up other components in the circuit and these will have to be replaced. Often the damaged components can be found by visual inspection, but others may require more rigorous testing. The usual failure is a change in value of resistors. One way to find bad tubes is to replace all tubes in a suspected circuit; then if the trouble is corrected, replace the old tubes one at a time until the bad ones are found.

Do not attempt to adjust this amplifier unless an oscilloscope is available that has a band width wide enough to observe the rise time of the output pulse which is less than 8 millimicroseconds. At the time of this writing, the author knows of only one scope with a suitable rise time, the Tektronix 517. In the absence of such a scope, it is possible to terminate a 185 ohm cable at the deflection plates and bypass the amplifiers of the scope. This can be done only with a CRT with sufficient sensitivity for the 40V signal to cause two or three centimeters of deflection. The schematic of a suitable termination is shown in the appendix.

Terminate both outputs and observe the positive output. Adjust the dynode voltage for maximum pulse height output. This voltage will be about 60 volts. Next with the pulse shape control in its center position, adjust the grid bias until the positive pulse is symmetrical and uniform in shape. Both of these adjustments should be made at a low repetition rate and narrow pulse width. Since there is some interdependence, it may be necessary to adjust the two controls alternately a couple of times.

To adjust the delay lines proceed as follows: With both outputs terminated and the scope connected to the positive output, observe the trailing edge of the pulse, and adjust C-58 for minimum overshoot, then C-17 for minimum ringing, and finally C-12, C-22, C-32, C-42, C-52, and C-62 in that order for minimum ripples on the base line while at the same time keeping the base line straight. There is some interaction between these adjustments, therefore, it may be necessary to repeat the procedure a few times. Next, connect the scope to the negative output and while observing the trailing edge,

proceed in a like manner to adjust C-67 for minimum overshoot, C-18 for minimum reflections and C-13, C-23, C-33, C-43, C-53 and C-63 for minimum ripple while keeping the base line flat. Again it may be necessary to go thru the alignment procedure a few times.

There is some interaction between the plate and dynode lines because of the interelectrode capacitance. Therefore, it may be necessary to readjust the dynode line after aligning the plate line and vice-versa.

When the dynode and plate lines are lined up and free from ringing and overshoot, the grid line can be lined up. Connect the scope to the positive output and observe the leading edge. Adjust C-14 for minimum overshoot, C-54 for minimum reflections, and C-60, C-50, C-40, C-30, C-20 and C-10 in that order for minimum ripple on top of the pulse. Since there is some interaction between these adjustments, it may be necessary to repeat the alignment procedure a couple of times.

ABBREVIATIONS

CER. CERAMIC	UH MICROHENRY OR 10^{-6} HENRY
COMP. COMPOSITION	PF PICOFARAD OR 10^{-12} FARAD
EMC ELECTROLYTIC, METAL CASED	PMC PAPER, METAL CASED
GMV GUARANTEED MINIMUM VALUE	PREC. PRECISION
H HENRY	PT PAPER TUBULAR
K KILOHM OR 10^{3} OHMS	S MICA SILVERED MICA
MEG MEGOHM OR 10^{6} OHMS	V WORKING VOLTS DC
MF MICROFARAD OR 10^{-6} FARAD	VAR. VARIABLE
MH MILLIHENRY OR 10^{-3} HENRY	W WATT
MP METALLIZED PAPER	WW WIRE WOUND

MODEL 1009 - PULSE AMPLIFIER

CAPACITORS

C-10	3-12PF	500V	VAR. CER.	
C-11	.01MF	500V	FIXED CER.	20%
C-12	3-12PF	500V	VAR. CER.	
C-13	4-30PF	500V	VAR. CER.	
C-14	1.5-7PF	500V	VAR. CER.	
C-15	.01MF	1KV	FIXED CER.	GMV
C-16	10MF	450V	EMC	-20+50%
C-17	1.5-7PF	500V	VAR. CER.	
C-18	1.5-7PF	500V	VAR. CER.	
C-19	.01MF	1KV	FIXED CER.	GMV
C-20	3-12PF	500V	VAR. CER.	
C-21	.01MF	500V	FIXED CER.	20%
C-22	3-12PF	500V	VAR. CER.	
C-23	4-30PF	500V	VAR. CER.	
C-24	.01MF	1KV	FIXED CER.	GMV
C-25	10MF	450V	EMC	-20+50%
C-30	3-12PF	500V	VAR. CER	
C-31	.01MF	500V	FIXED CER.	20%
C-32	3-12PF	500V	VAR. CER.	
C-33	4-30PF	500V	VAR. CER.	
C-40	3-12PF	500V	VAR. CER.	
C-41	.01MF	500V	FIXED CER.	20%
C-42	3-12PF	500V	VAR. CER.	
C-43	4-30PF	500V	VAR. CER.	
C-50	3-12PF	500V	VAR. CER.	
C-51	.01MF	500V	FIXED CER.	20%
C-52	3-12PF	500V	VAR. CER.	
C-53	4-30PF	500V	VAR. CER.	
C-54	1.5-7PF	500V	VAR. CER.	
C-55	.01MF	1KV	FIXED CER.	GMV

MODEL 1009 - PULSE AMPLIFIER (CONT'D)

CAPACITORS (CONT'D)

C-56	.01MF	1KV	FIXED CER.	GMV
C-57	10MF	450V	EMC	-20+50%
C-58	1.5-7PF	500V	VAR. CER.	
C-59	2MF	450V	EMC	-20+50%
C-60	3-12PF	500V	VAR. CER.	
C-61	.01MF	500V	FIXED CER.	20%
C-62	3-12PF	500V	VAR. CER.	
C-63	4-30PF	500V	VAR. CER.	
C-64	.1MF	500V	FIXED CER.	GMV
C-65	.1MF	500V	FIXED CER.	GMV
C-66	2MF	450V	EMC	-20+50%
C-67	1.5-7PF	500V	VAR. CER.	
C-68	.01MF	500V	FIXED CER.	GMV

CHOKES

L-10	SPECIAL	1009-E-501
L-11	SPECIAL	1009-E-501
L-12	SPECIAL	1009-E-501

DIODES

X-10	1N98
X-20	1N98
X-30	1N98
X-40	1N98
X-50	1N98
X-60	1N98

ELECTRON TUBES

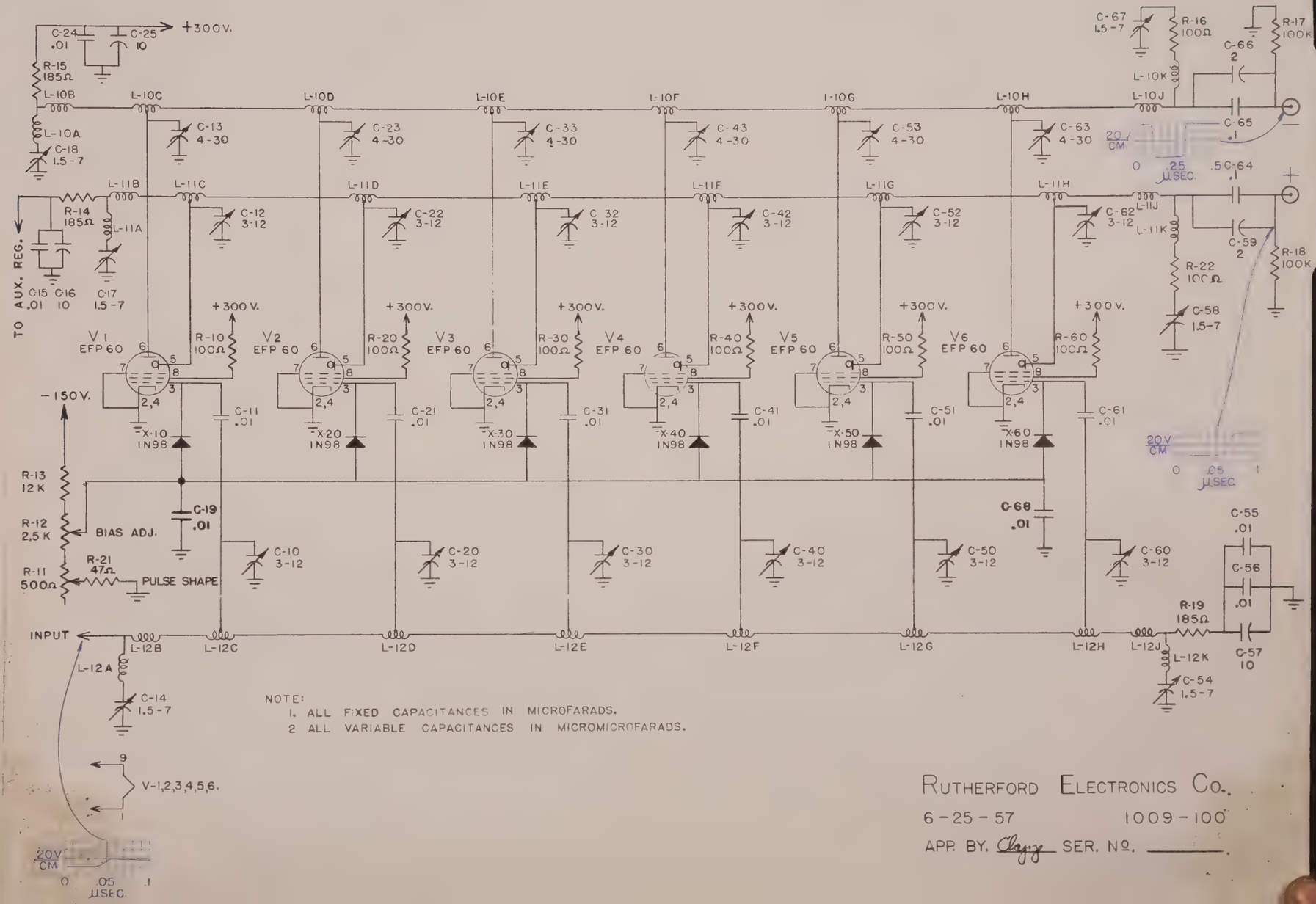
V-1	EFP 60	AMPLIFIER
V-2	EFP 60	AMPLIFIER
V-3	EFP 60	AMPLIFIER
V-4	EFP 60	AMPLIFIER
V-5	EFP 60	AMPLIFIER
V-6	EFP 60	AMPLIFIER

RESISTORS

R-10	100 OHM	½W	FIXED COMP.	10%
R-11	500 OHM		VAR.	
R-12	2.5K "		VAR.	
R-13	12K	2W	FIXED COMP.	10%
R-14	185 OHM	5W	FIXED PREC.	1%
R-15	185 OHM	5W	FIXED PREC.	1%
R-16	100 OHM	½W	FIXED COMP.	10%
R-17	100K	½W	FIXED COMP.	10%
R-18	100K	½W	FIXED COMP.	10%
R-19	185 OHM	5W	FIXED PREC.	1%
R-20	100 OHM	½W	FIXED COMP.	10%
R-21	47 OHM	½W	FIXED COMP.	10%
R-30	100 OHM	½W	FIXED COMP.	10%
R-40	100 OHM	½W	FIXED COMP.	10%
R-50	100 OHM	½W	FIXED COMP.	10%
R-60	100 OHM	½W	FIXED COMP.	10%

WAVEFORMS

These waveforms were reproduced from photographs taken with a Tektronix type 517A oscilloscope.



RUTHERFORD ELECTRONICS CO.

6-25-57 1009-100

APP. BY. Clay SER. NO. _____

ABBREVIATIONS

CER. CERAMIC	UH MICROHENRY OR 10^{-6} HENRY
COMP. COMPOSITION	PF PICOFARAD OR 10^{-12} FARAD
EMC ELECTROLYTIC, METAL CASED	PMC PAPER, METAL CASED
GMV GUARANTEED MINIMUM VALUE	PREC. PRECISION
H HENRY	PT PAPER TUBULAR
K KILOHM OR 10^{3} OHMS	S MICA SILVERED MICA
MEG MEGOHM OR 10^{6} OHMS	V WORKING VOLTS DC
MF MICROFARAD OR 10^{-6} FARAD	VAR. VARIABLE
MH MILLIHENRY OR 10^{-3} HENRY	W WATT
MP METALLIZED PAPER	WW WIRE WOUND

MODEL 1009 - AUXILIARY REGULATOR

CAPACITORS

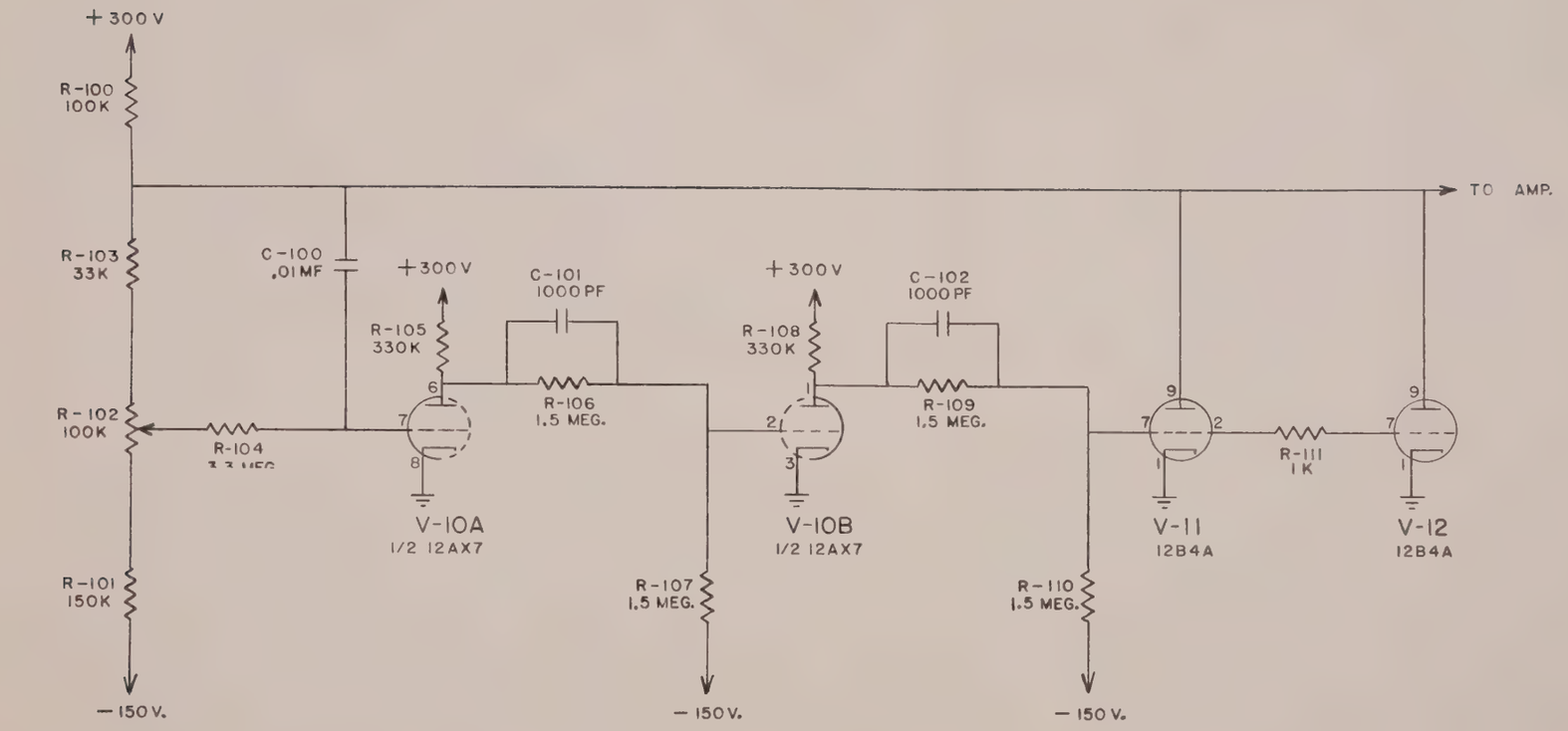
C-100	.01MF	500V	FIXED CER.	20%
C-101	1000PF	500V	FIXED CER.	10%
C-102	1000PF	500V	FIXED CER.	10%

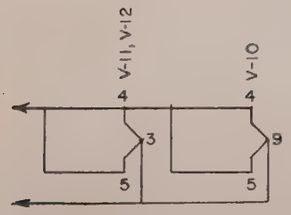
ELECTRON TUBES

V-10	12AX7	AMPLIFIER
V-11	12B4-A	SHUNT TUBE
V-12	12B4-A	SHUNT TUBE

RESISTORS

R-100	100K	½W	FIXED COMP.	10%
R-101	150K	½W	FIXED COMP.	10%
R-102	100K	2W	VAR. COMP.	10%
R-103	33K	½W	FIXED COMP.	10%
R-104	3.3 MEG	½W	FIXED COMP.	10%
R-105	330K	½W	FIXED COMP.	10%
R-106	1.5 MEG	½W	FIXED COMP.	10%
R-107	1.5 MEG	½W	FIXED COMP.	10%
R-108	330K	½W	FIXED COMP.	10%
R-109	1.5 MEG	½W	FIXED COMP.	10%
R-110	1.5 MEG	½W	FIXED COMP.	10%
R-111	1K	½W	FIXED COMP.	10%



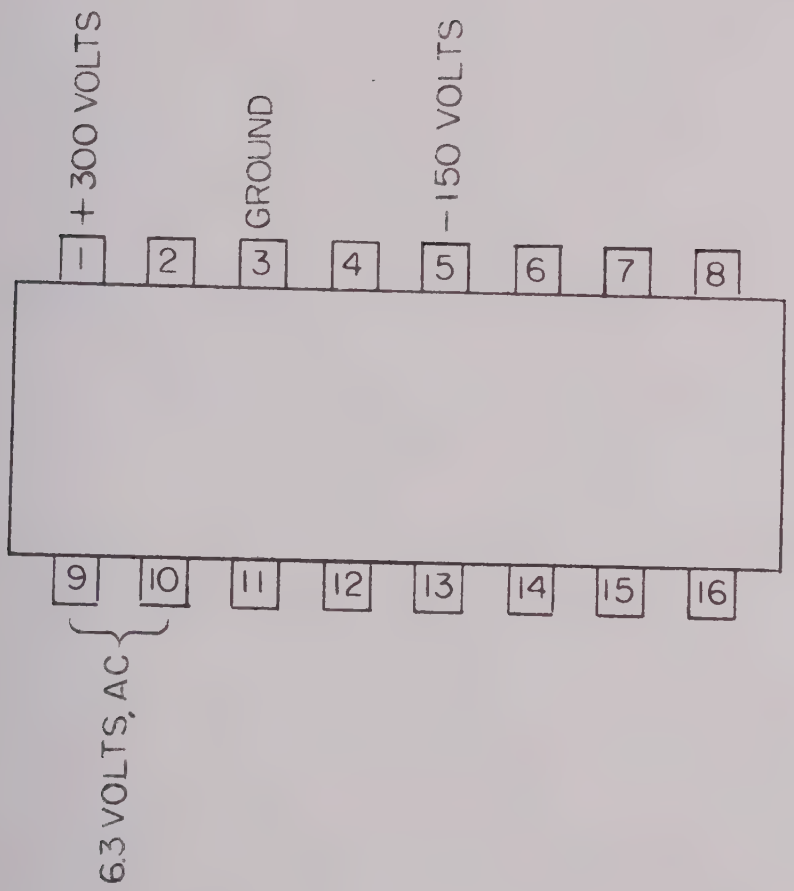


RUTHERFORD ELECTRONICS CO.

6 - 26 - 57 1009 -101

APP. BY. Clapp SER. NO. _____

AUX. REGULATOR SCHEMATIC



Rutherford

PLUG DIAGRAM

9-23-58 1009-102A

DR. Owen APP. WFS

INSTRUCTION BOOK

ATTENUATOR
MODEL 1014

Serial No. 184

Price $2.00

Rutherford ELECTRONICS CO.
8944 LINDBLADE ST., CULVER CITY, CALIF
TExas 0-7393

ABBREVIATIONS

CER. CERAMIC
COMP. COMPOSITION
EMC ELECTROLYTIC, METAL CASED
GMV GUARANTEED MINIMUM VALUE
H HENRY
K KILOHM OR 10^{3} OHMS
MEG MEGOHM OR 10^{6} OHMS
MF MICROFARAD OR 10^{-6} FARAD
MH MILLIHENRY OR 10^{-3} HENRY
MP METALLIZED PAPER
μH MICROHENRY OR 10^{-6} HENRY
PF PICOFARAD OR 10^{-12} FARAD
PMC PAPER, METAL CASED
PREC. PRECISION
PT PAPER TUBULAR
S MICA SILVERED MICA
V WORKING VOLTS DC
VAR. VARIABLE
W WATT
WW WIRE WOUND

MODEL 1014 - ATTENUATOR

CHOKES

L-10A	.12μH	FIXED	20%
L-10B	.12μH	FIXED	20%
L-10C	.12μH	FIXED	20%
L-10D	.12μH	FIXED	20%
L-10E	.19μH	FIXED	20%
L-10F	.12μH	FIXED	20%
L-20	.25μH	FIXED	20%
L-30	.25μH	FIXED	20%
L-40	.25μH	FIXED	20%
L-50	.25μH	FIXED	20%
L-60	.18μH	FIXED	20%

RESISTORS

R-10A	130 OHM	2W	FIXED PREC.	1%
R-10B	130 OHM	$\frac{1}{2}$W	FIXED PREC.	1%
R-10C	130 OHM	$\frac{1}{2}$W	FIXED PREC.	1%
R-10D	130 OHM	$\frac{1}{2}$W	FIXED PREC.	1%
R-10E	130 OHM	$\frac{1}{2}$W	FIXED PREC.	1%

MODEL 1014 - ATTENUATOR (CONT'D)

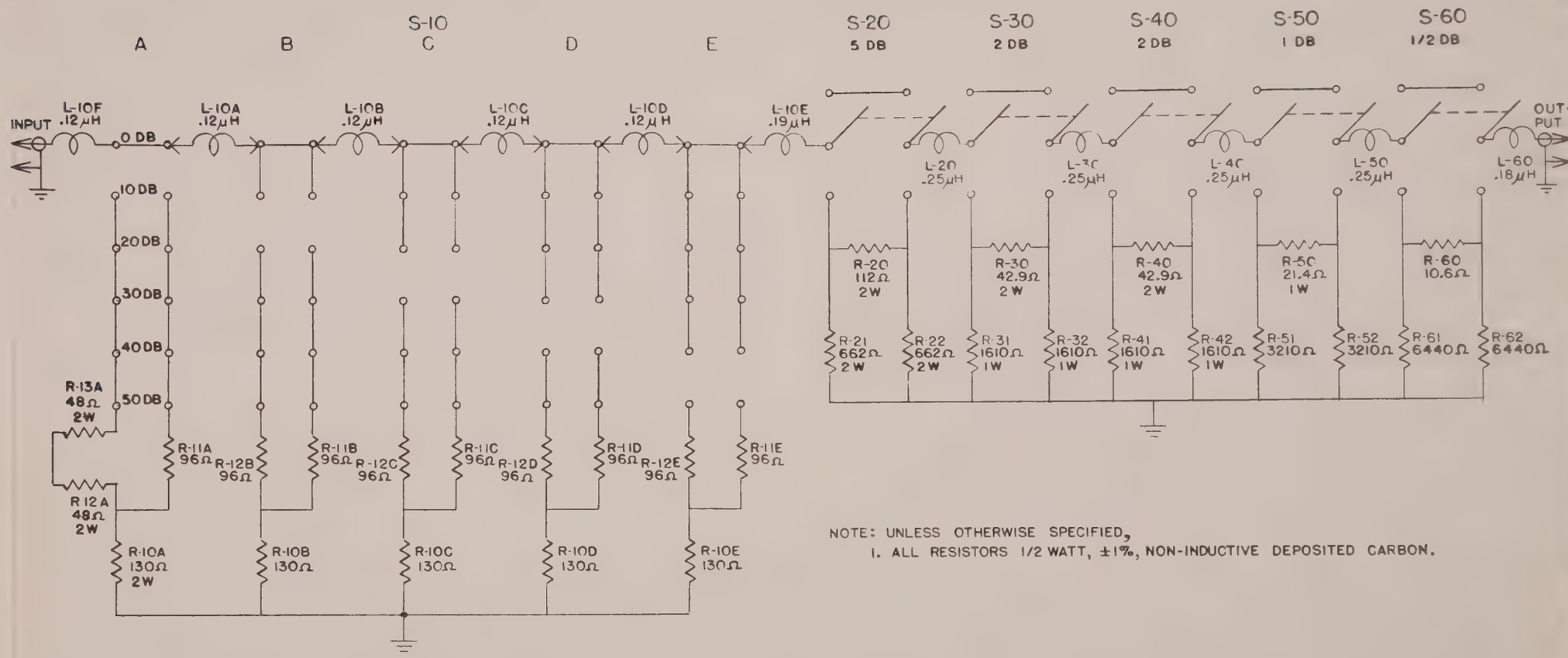
RESISTORS (CONT'D)

R-11A	96 OHM	⅛W	FIXED PREC.	1%
R-11B	96 OHM	⅛W	FIXED PREC.	1%
R-11C	96 OHM	⅛W	FIXED PREC.	1%
R-11D	96 OHM	⅛W	FIXED PREC.	1%
R-11E	96 OHM	⅛W	FIXED PREC.	1%
R-12A	48 OHM	2W	FIXED PREC.	1%
R-12B	96 OHM	⅛W	FIXED PREC.	1%
R-12C	96 OHM	⅛W	FIXED PREC.	1%
R-12D	96 OHM	⅛W	FIXED PREC.	1%
R-12E	96 OHM	½W	FIXED PREC.	1%
R-13A	48 OHM	2W	FIXED PREC.	1%
R-20	112 OHM	2W	FIXED PREC.	1%
R-21	662 OHM	2W	FIXED PREC.	1%
R-22	662 OHM	2W	FIXED PREC.	1%
R-30	42.9 OHM	2W	FIXED PREC.	1%
R-31	1610 OHM	1W	FIXED PREC.	1%
R-32	1610 OHM	1W	FIXED PREC.	1%
R-40	42.9 OHM	2W	FIXED PREC.	1%
R-41	1610 OHM	1W	FIXED PREC.	1%
R-42	1610 OHM	1W	FIXED PREC.	1%
R-50	21.4 OHM	1W	FIXED PREC.	1%
R-51	3210 OHM	⅛W	FIXED PREC.	1%
R-52	3210 OHM	⅛W	FIXED PREC.	1%
R-60	10.6 OHM	⅛W	FIXED PREC.	1%
R-61	6440 OHM	⅛W	FIXED PREC.	1%
R-62	6440 OHM	½W	FIXED PREC.	1%

MODEL 1014 - ATTENUATOR (CONT'D)

SWITCHES

S-10	300-A-502A		OAK
S-20	DPDT	81027	ARROW-HART & HEGEMAN
S-30	DPDT	81027	ARROW-HART & HEGEMAN
S-40	DPDT	81027	ARROW-HART & HEGEMAN
S-50	DPDT	81027	ARROW-HART & HEGEMAN
S-60	DPDT	81027	ARROW-HART & HEGEMAN



NOTE: UNLESS OTHERWISE SPECIFIED,
1. ALL RESISTORS 1/2 WATT, ±1%, NON-INDUCTIVE DEPOSITED CARBON.

RUTHERFORD ELECTRONICS CO.

9 – 25 – 57 1014–100

APP. BY Clapp SER. NO. _____

INSTRUCTION BOOK

POWER SUPPLY
MODEL 1013A

Serial No. 182

Price $2.00

Rutherford ELECTRONICS CO.
8944 LINDBLADE ST., CULVER CITY, CALIF
TExas 0-7393

MODEL 1013A

GENERAL DESCRIPTION

The Model 1013A power supply is a highly stable series regulated power supply with fixed output voltages of -150, +100, +150, and +300 volts.

SPECIFICATIONS:

Output voltages + 300 VDC @ 250 ma
+ 150 VDC @ 600 ma
+ 100 VDC @-25 ma
-150 VDC @ 100 ma
6.3 VAC @ 15 amp CT gnd
6.3 VAC @ 5 amp one side gnd

Power Requirements - 105-125 VAC, 50-60 CPS, 700 Watts Maximum.

OPERATING INSTRUCTIONS

Cooling

The Model 1013 will cool itself by convection, if operated in a location with unrestricted airflow and normal temperatures. If, however, the unit is mounted in a cabinet or rack with other equipment, forced ventilation will probably be required.

Function of Controls

On-Off Switch - Toggle switch controls input power to the supply
Fuse - 6¼ Amp. slo-blow fuse in the input circuit.
Pilot - Indicates instrument is operating.

CIRCUIT DESCRIPTION

Transformer - Plate and heater power is provided by a single power transformer, T-500. The primary is wound for 115 Volts, 50-60 cycle operation. The power supply will operate satisfactorily over the voltage range of 105 to 125 volts. There are 6 secondary windings, 3 high voltage and 3 heater.

Rectifiers - The A.C. from the high voltage secondaries of the transformer is rectified by full wave bridge connected rectifiers.

Regulation --150 Volt Supply

Reference voltage for the -150 volt supply is furnished by a gas diode voltage reference tube, V-10, to the grid of the comparator amplifier, V-11. The grid potential of V-11B, established by the gas diode, is compared against the grid voltage of V-11A. The grid voltage of V-11A is obtained from a voltage divider of R-113, R-116 and R-114, which divides down the voltage of the -150 volts being regulated. R-116, labeled -150 volt adjust on the chassis, is a screwdriver adjustment that determines the percentage of the voltage division that appears at V-11A, and thereby determines the total voltage across the divider.

Regulation (Continued)

The difference between the voltages at the two grids of V-11 shows up as an amplified error signal at the plate of V-11A. This error signal is further amplified by V-12, which is DC coupled to the plate of V-11A and to the grids of the series tubes, V-15 and V-16.

The series tubes change their plate to Cathode resistance according to their grid to Cathode potential. The DC coupled error signal at the grids controls their plate resistance so as to change the drop across the tubes in the right direction to maintain the 150 volts constant.

C-110 and C-120 by-passing the DC coupled dividers, increase the AC gain of the loop and thereby reduce the ripple. Further ripple reduction is accomplished by feeding the screen of V-12 with a small amount of the ripple that exists ahead of the regulators. The phase of the amplified ripple that appears at the plate of V-12 is such as to buck out most of the ripple on the -150 volt bus. C-130 connected between the -150 volt bus and ground keeps the output impedance low at frequencies above the cut-off frequency of the feedback amplifier and prevents any oscillations that might occur at high frequencies because of phase shift in the feedback amplifiers.

+150 Volt Regulator

The comparator tube, V-20, compares the taped down voltage of divider R-204 and R-203 connected to the -150 volts as a reference to ground. Any difference in the potential between the two grids of V-20 shows up as an amplified error signal at the plate of V-20A. This error signal is further amplified by V-21. V-21 is DC coupled to the plate of V-20 and the grids of the series tubes, V-25, V-26, and V-27.

The series tubes change their plate to cathode resistance with change in grid to cathode voltage in such a way as to maintain the +150 volts constant.

High frequency gain is increased by C-200 and C-210. Further ripple reduction is obtained by feeding the screen of V-21 with a portion of the ripple appearing before the series tubes. This amplified ripple is of the proper phase to buck out the ripple on the +150 volt bus.

+300 Volt Regulator

The comparator, V-30, compares the divided down voltage to ground and the amplified error signal is further amplified by V-31. V-31 is DC coupled to V-30 and to the series tubes, V-35, V-36, V-37, V-38 and V-39.

Screen injection of ripple voltage to V-31 is used. C-300 and C-310 increase the high frequency gain of the feedback amplifiers.

+100 Volt Regulator.

The 100 volt regulator is a 0B2 tube V-40. Current for this regulator tube is taken from the 150 volt regulated supply thru draping resistor R-400. The value of R-400 is chosen to pass the minimum current required by the 0B2 during quiescent conditions; therefore current cannot be drawn from this supply. In operation, current from the higher voltage supplies is returned to this 100 volt supply, hence the negative current rating.

MAINTENANCE

Troubles are usually caused by tube failure, and can be corrected by finding the defective tubes and replacing them. Sometimes a tube failure will burn out resistors or other components in the circuit and these will have to be replaced. Often the damaged components can be found by visual inspection, but others may require more rigorous testing. The usual failure is a change in value of resistors. One way to find bad tubes is to replace all tubes in a suspected circuit; then, if the trouble is corrected, replace the old tubes one at a time until the bad ones are found.

The -150 volts is used as reference for the +300 and +150 volt supplies, therefore, the -150 volt regulator must be operating before the positive voltage regulators can be serviced. The -150 volts is adjusted by R-116, labeled -150 volt adjust on the chassis.

ABBREVIATIONS

CER. CERAMIC
COMP. COMPOSITION
EMC ELECTROLYTIC, METAL CASED
GMV GUARANTEED MINIMUM VALUE
H HENRY
K KILOHM OR 10^{3} OHMS
MEG MEGOHM OR 10^{6} OHMS
MF MICROFARAD OR 10^{-6} FARAD
MH MILLIHENRY OR 10^{-3} HENRY
MP METALLIZED PAPER
UH MICROHENRY OR 10^{-6} HENRY
PF PICOFARAD OR 10^{-12} FARAD
PMC PAPER, METAL CASED
PREC. PRECISION
PT PAPER TUBULAR
S MICA SILVERED MICA
V WORKING VOLTS DC
VAR. VARIABLE
W WATT
WW WIRE WOUND

MODEL 1013 - POWER SUPPLY

CAPACITORS

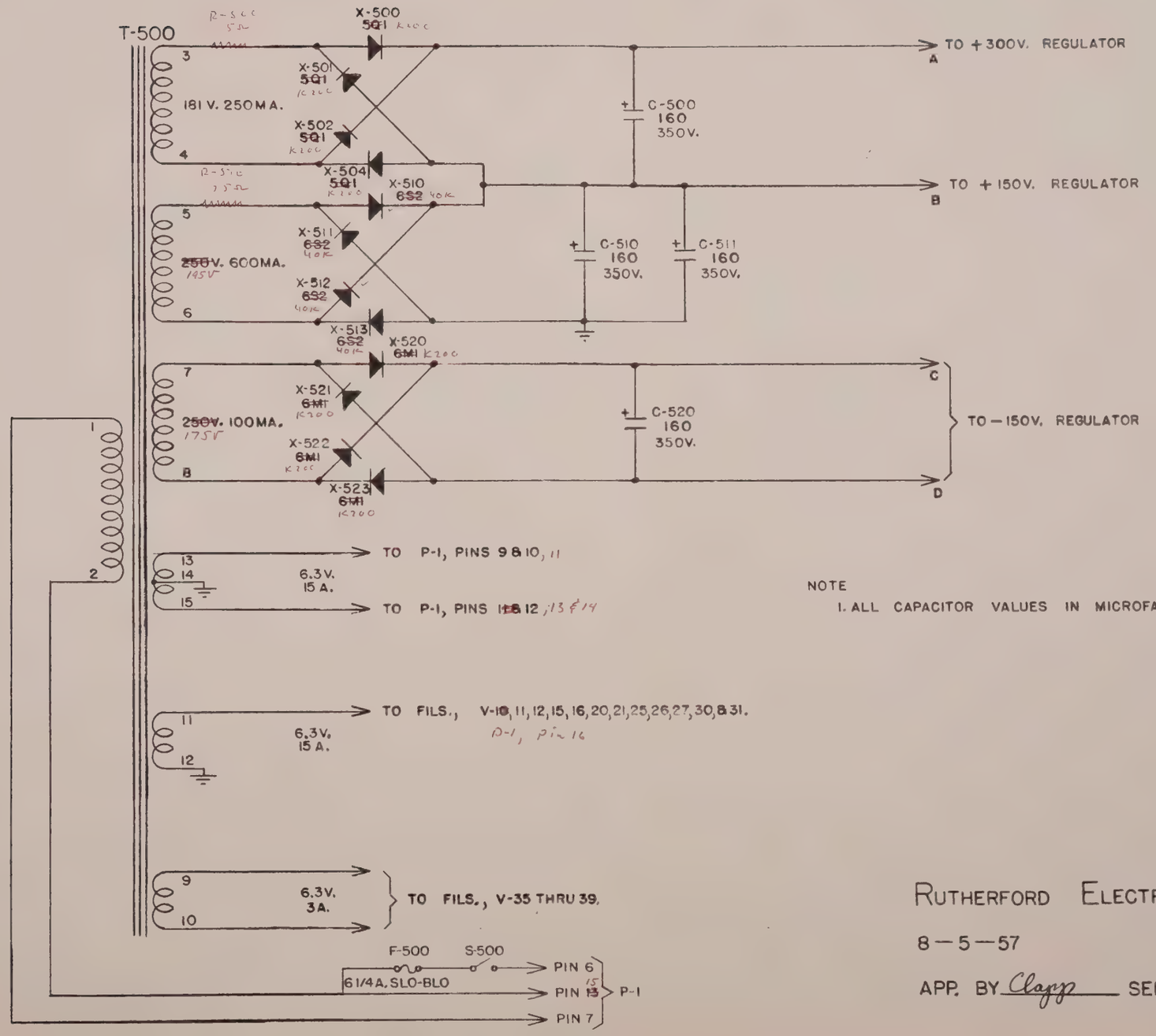
C-500	160MF	350V	EMC	-20+50%
C-510	160MF	350V	EMC	-20+50%
C-511	160MF	350V	EMC	-20+50%
C-520	160MF	350V	EMC	-20+50%

RECTIFIERS

X-500	~~5Q1~~ K200 silicon diodes
X-501	~~5Q1~~ K200
X-502	~~5Q1~~ K200
X-503	~~5Q1~~ K200
X-510	~~6S2~~ 40K
X-511	~~6S2~~ 40K
X-512	~~6S2~~ 40K
X-513	~~6S2~~ 40K
X-520	~~6M1~~ K200
X-521	~~6M1~~ K200
X-522	~~6M1~~ K200
X-523	~~6M1~~ K200

TRANSFORMER

T-500	SPECIAL	1013-D-500



NOTE

1. ALL CAPACITOR VALUES IN MICROFARADS.

RUTHERFORD ELECTRONICS CO.

8—5—57 1013—100

APP. BY Clapp SER. NO. _____

POWER SUPPLY SCHEMATIC

ABBREVIATIONS

CER. CERAMIC	UH MICROHENRY OR 10^{-6} HENRY
COMP. COMPOSITION	PF PICOFARAD OR 10^{-12} FARAD
EMC ELECTROLYTIC, METAL CASED	PMC PAPER, METAL CASED
GMV GUARANTEED MINIMUM VALUE	PREC. PRECISION
H HENRY	PT PAPER TUBULAR
K KILOHM OR 10^{3} OHMS	S MICA SILVERED MICA
MEG MEGOHM OR 10^{6} OHMS	V WORKING VOLTS DC
MF MICROFARAD OR 10^{-6} FARAD	VAR. VARIABLE
MH MILLIHENRY OR 10^{-3} HENRY	W WATT
MP METALLIZED PAPER	WW WIRE WOUND

MODEL 1013 - REGULATOR

CAPACITORS

C-110	.01MF	500V	FIXED CER.	GMV
C-111	.01MF	500V	FIXED CER.	GMV
C-120	.01MF	500V	FIXED CER.	GMV
C-130	~~2MF~~ 20MF	~~450V~~ 250V	FIXED EMC	-20+50%
C-200	.01MF	500V	FIXED CER.	GMV
C-210	.01MF	500V	FIXED CER.	GMV
C-251	~~2MF~~ 20MF	~~450V~~ 250V	FIXED EMC	-20+50%
C-300	.01MF	500V	FIXED CER.	GMV
C-310	.01MF	500V	FIXED CER.	GMV
C-351	~~2MF~~ 20MF	450V	FIXED EMC	-20+50%

ELECTRON TUBES

V-10	5651	VOLTAGE REFERENCE	-150V REGULATOR
V-11	12AX7	VOLTAGE AMPLIFIER	
V-12	6AU6	VOLTAGE AMPLIFIER	
V-15	12B4-A	SERIES TUBE	
V-16	12B4-A	SERIES TUBE	

MODEL 1013 - REGULATOR (CONT'D)

ELECTRON TUBES (CONT'D)

V-20	12AX7	VOLTAGE AMPLIFIER	+ 150V REGULATOR
V-21	6AU6	VOLTAGE AMPLIFIER	
V-25	6080	SERIES TUBE	
V-26	6080	SERIES TUBE	
V-27	6080	SERIES TUBE	
V-30	12AX7	VOLTAGE AMPLIFIER	+ 300V REGULATOR
V-31	6AU6	VOLTAGE AMPLIFIER	
V-35	12B4-A	SERIES TUBE	
V-36	12B4-A	SERIES TUBE	
V-37	12B4-A	SERIES TUBE	
V-38	12B4-A	SERIES TUBE	
V-39	12B4-A	SERIES TUBE	
V-40	OB2	VOLTAGE REGULATOR	+ 100V REGULATOR

RESISTORS

R-100	33K	½W	FIXED COMP.	10%
R-101	100K	½W	FIXED COMP.	10%
R-110	100K	½W	FIXED COMP.	10%
R-111	390 OHM	½W	FIXED COMP.	10%
R-112	3.3 MEG	½W	FIXED COMP.	10%
R-113	68K	½W	FIXED PREC.	1%
R-114	50K	½W	FIXED PREC.	1%
R-115	470K	½W	FIXED COMP.	10%
R-116	10K	2W	VAR. WW	10%
R-120	150K	½W	FIXED COMP.	10%
R-121	68K	½W	FIXED COMP.	10%
R-122	2.7 MEG	½W	FIXED COMP.	10%
R-123	2.2 MEG	½W	FIXED COMP.	10%
R-124	15K	1W	FIXED COMP.	10%
R-125	27K	½W	FIXED COMP.	10%
R-126	15K	1W	FIXED COMP.	10%
R-127	1 MEG	½W	FIXED COMP.	10%
R-150	33 OHM	½W	FIXED COMP.	10%

MODEL 1013 - REGULATOR (CONT'D)

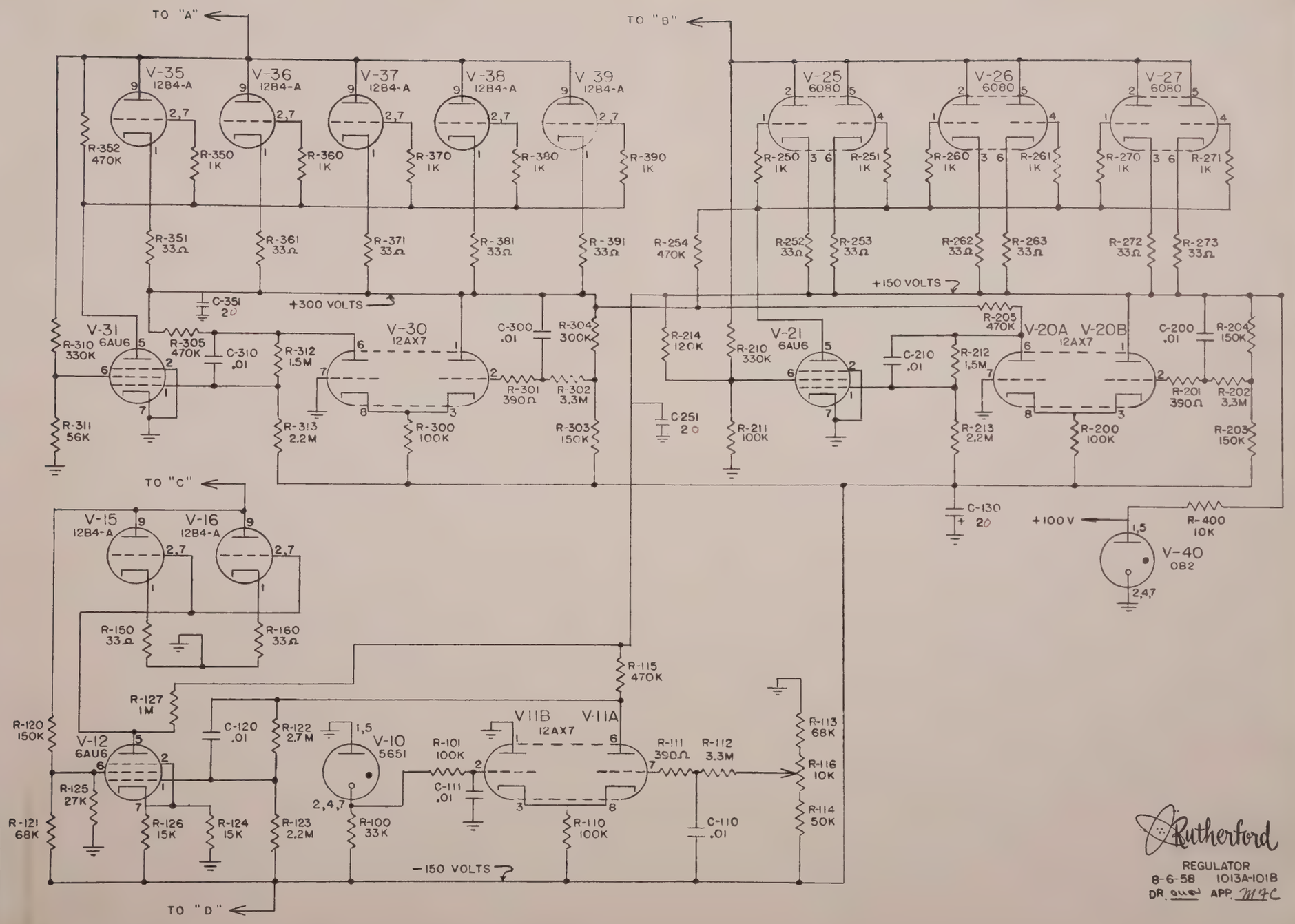
RESISTORS (CONT'D)

R-160	33 OHM	½W	FIXED COMP.	10%
R-200	100K	½W	FIXED COMP.	10%
R-201	390 OHM	½W	FIXED COMP.	10%
R-202	3.3 MEG	½W	FIXED COMP.	10%
R-203	150K	½W	FIXED PREC.	1%
R-204	150K	½W	FIXED PREC.	1%
R-205	470K	½W	FIXED COMP.	10%
R-210	330K	½W	FIXED COMP.	10%
R-211	100K	½W	FIXED COMP.	10%
R-212	1.5 MEG	½W	FIXED COMP.	10%
R-213	2.2 MEG	½W	FIXED COMP.	10%
R-214	120K	½W	FIXED COMP.	10%
R-250	1K	½W	FIXED COMP.	10%
R-251	1K	½W	FIXED COMP.	10%
R-252	33 OHM	½W	FIXED COMP.	10%
R-253	33 OHM	½W	FIXED COMP.	10%
R-254	470K	½W	FIXED COMP.	10%
R-260	1K	½W	FIXED COMP.	10%
R-261	1K	½W	FIXED COMP.	10%
R-262	33 OHM	½W	FIXED COMP.	10%
R-263	33 OHM	½W	FIXED COMP.	10%
R-270	1K	½W	FIXED COMP.	10%
R-271	1K	½W	FIXED COMP.	10%
R-272	33 OHM	½W	FIXED COMP.	10%
R-273	33 OHM	½W	FIXED COMP.	10%
R-300	100K	½W	FIXED COMP.	10%
R-301	390 OHM	½W	FIXED COMP.	10%
R-302	3.3 MEG	½W	FIXED COMP.	10%
R-303	150K	½W	FIXED PREC.	1%
R-304	300K	½W	FIXED PREC.	1%
R-305	470K	½W	FIXED COMP.	10%

MODEL 1013 - REGULATOR (CONT'D)

RESISTORS (CONT'D)

R-310	330K	½W	FIXED COMP.	10%
R-311	56K	½W	FIXED COMP.	10%
R-312	1.5 MEG	½W	FIXED COMP.	10%
R-313	2.2 MEG	½W	FIXED COMP.	10%
R-350	1K	½W	FIXED COMP.	10%
R-351	33 OHM	½W	FIXED COMP.	10%
R-352	470K	½W	FIXED COMP.	10%
R-360	1K	½W	FIXED COMP.	10%
R-361	33 OHM			
R-370	1K	½W	FIXED COMP.	10%
R-371	33 OHM	½W	FIXED COMP.	10%
R-380	1K	½W	FIXED COMP.	10%
R-381	33 OHM	½W	FIXED COMP.	10%
R-390	1K	½W	FIXED COMP.	10%
R-391	33 OHM	½W	FIXED COMP.	10%
R-400	10K	1W	FIXED COMP.	10%



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C			
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A	9-18-58	158	ALLEN

Rutherford

REGULATOR

8-6-58 1013A-101B

DR. ALLEN APP. MFC

REGULATOR SCHEMATIC

Rutherford

PLUG DIAGRAM

9-23-58 1013-102B

DR. OLEN APP. MTS

INSTRUCTION BOOK

APPENDIX

Rutherford ELECTRONICS CO.
8944 LINDBLADE ST., CULVER CITY, CALIF
TExas 0-7393

APPENDIX

REPLACEMENT OF COMPONENTS

Rutherford Electronics Co. will supply replacement parts at current net prices. Since most of the components are standard electronics and radio parts, a considerable savings in time will be effected if these parts are purchased from your local dealer. Be sure to consult the instruction manual to determine the tolerance and voltage ratings required. A few parts are manufactured to our specifications and are not generally available through local channels. These parts are noted in the parts list either by our part number or by a note. Order these parts from Rutherford Electronics Co. in Culver City, Calif.

SERIAL NUMBERS

Every unit manufactured by Rutherford Electronics Co., carries a serial number located on the right rear support plate, (opposite side from power connector) as well as a model designation. (Silk screened on the front panel). When several of these units are assembled into a system or instrument, the instrument also has a serial number stamped into the right rear support rail. An instruction book consists of a separate section for each unit as well as a section for the instrument. The front sheet of each section carries the serial number of the unit or instrument for which it was prepared, and the instrument section always comes first.

PARTS ORDERING INFORMATION

Before ordering parts be sure that the serial number of the instruction book section agrees with the unit being repaired. This is important since Rutherford Electronics Co., instructions books usually contain handmade changes to the schematics and parts lists. These changes show changes to the instrument that have been made since the manual was printed. Some of the instrument changes are made during the checkout procedure to obtain the best possible performance.

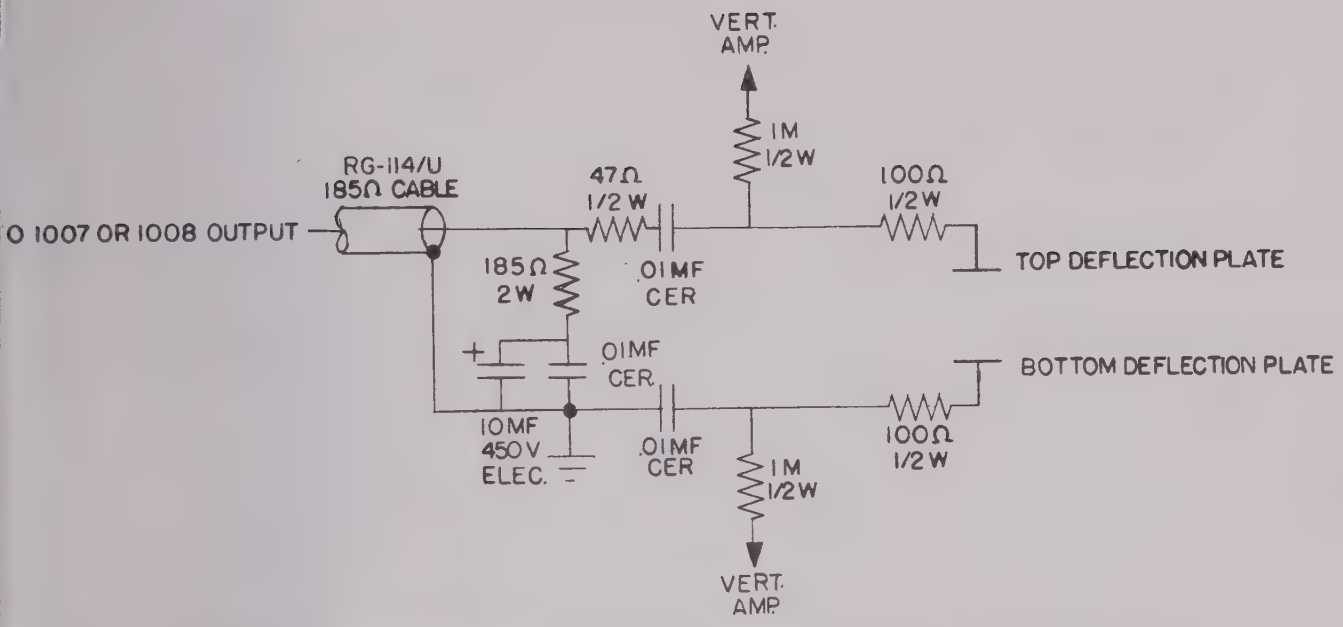
When ordering parts, supply all of the information given in the parts list. If any question exists, also supply the component number and model and serial number of the sub-unit under repair.

WARRANTY

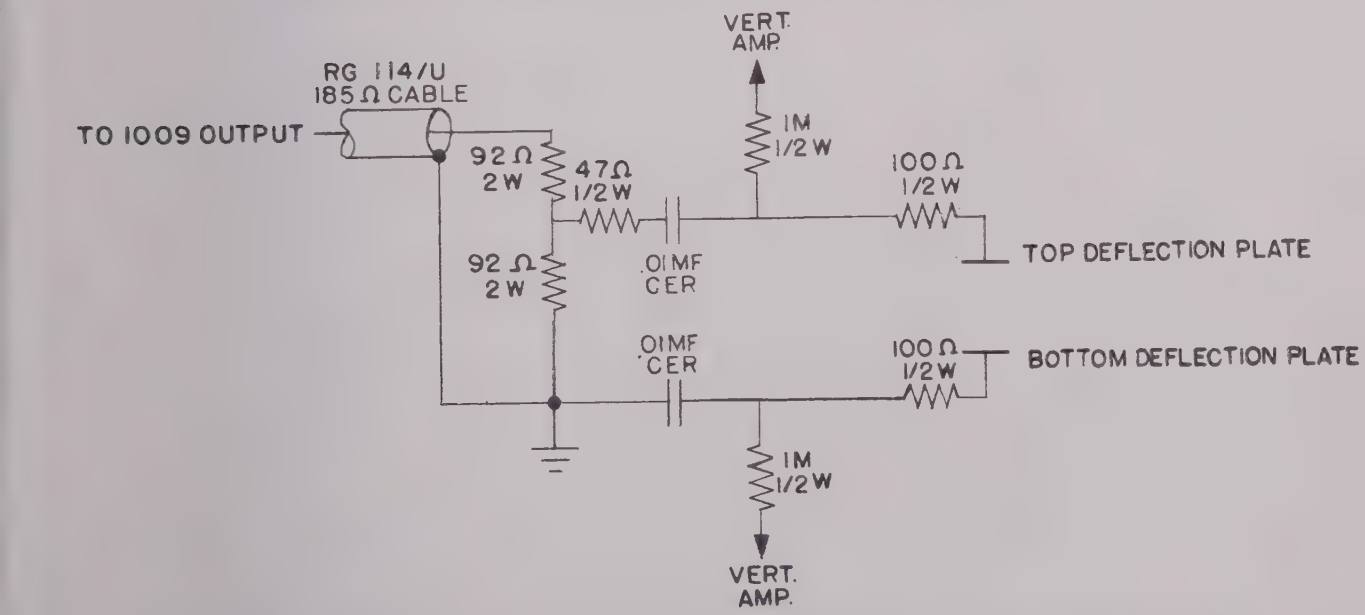
Rutherford Electronics Co., guarantees to the original purchaser for a period of one year, except vacuum tubes which are guaranteed for ninety days, that this instrument is free from defects in material and workmanship. Our liability is limited to repair or replacement of this instrument, or any part thereof, providing failure is not due to misuse or abnormal conditions.

In order to receive service under this warranty, promptly advise the factory of all details pertinent to failure of the instrument. Replacement parts will be shipped via air transportation if requested, prepaid to any point in the continental United States. Should it be desirable to return the instrument, ship it prepaid to the factory, and it will be serviced as required and returned via surface transportation, prepaid.

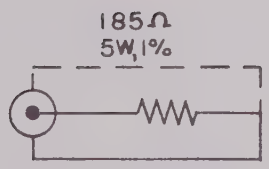
Service required after the expiration of warranty, or because of misuse or abnormal conditions will be billed at cost.



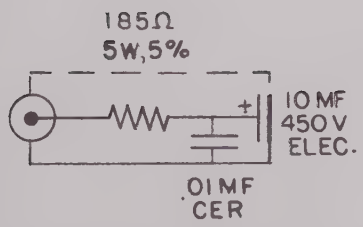
IRCUIT FOR DIRECT CONNECTION TO DEFLECTION PLATES OF SYNCROSCOPE
FOR CHECKING MODEL 1007 OR 1008 OUTPUT



CIRCUIT FOR DIRECT CONNECTION TO DEFLECTION PLATES OF SYNCROSCOPE
FOR CHECKING MODEL 1009 OUTPUT



B-5-800 TERMINATION



B-5-801 CAPACITIVE COUPLED
TERMINATION

a SHORT-FORM CATALOG of

Rutherford
PRECISION PULSE FORMING and TIMING INSTRUMENTS

10 MEGACYCLE
PULSE GENERATOR

The Rutherford Model B-5 Pulse Generator, which operates to 10 megacycles, is the highest repetition rate pulse generator commercially available. It constitutes a radical new development in high-repetition-rate, narrow-width pulse generators, giving an unparalleled combination of extremely narrow pulse widths, fast repetition rates, and fast rise times.

MODEL B-5

SPECIFICATIONS

MAIN PULSE:

PULSE WIDTH: continuously variable from .02 microsecond to 12.5 microseconds (duty factor limited to 25%) in four ranges:

.02 to .1 microsecond .5 to 2.5 microseconds
.1 to .5 microsecond 2.5 to 12.5 microseconds

AMPLITUDE: 40 volts Positive, 45 volts Negative

ATTENUATOR: 60 db in ½ db steps

RISE and FALL TIME: less than 8 millimicroseconds

POLARITY: both Positive and Negative pulses simultaneously available

OUTPUT IMPEDANCE: 185 ohms (the instrument must be terminated for proper pulse shape)

OUTPUT DECAY CONSTANT: 750 microseconds when terminated in 185 ohms

SYNCHRONIZING PULSE OUT:

15 volts positive

RISE TIME: less than .05 microsecond

WIDTH: varies with repetition rate, but is less than 700 microseconds

EXTERNAL TRIGGER:

Pulse required: 8 volts minimum with rise time less than .1 microsecond

PULSE REPETITION RATE:

Continuously variable from 1 cycle/ sec to 10 mc/sec in seven ranges:

1 c to 10 c 100 c to 1 kc 100 kc to 1 mc
10 c to 100 c 1 kc to 10 kc 1 mc to 10 mc
10 kc to 100 kc

DELAY:

A fixed delay of .14 microsecond occurs between the synchronizing pulse out and the main pulse

POWER REQUIRED:

105—125 volts, 50—60 cycles, 650 watts

CONNECTORS:

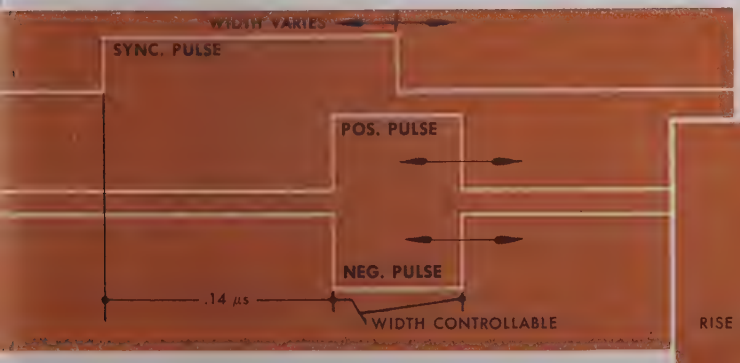
Sync. Pulse Out—type BNC
External Trigger—type BNC
Main Pulse—type C

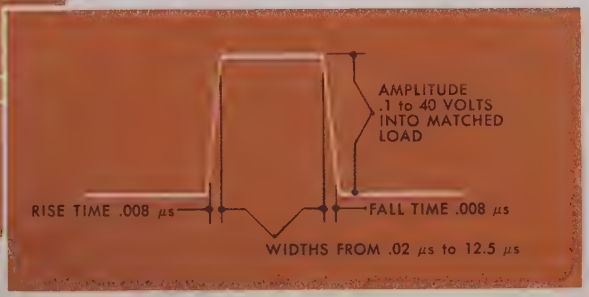
DIMENSIONS: 23" high, 23" wide, 16" deep

WEIGHT: 110 pounds

ACCESSORIES SUPPLIED:

1 unit extension cable
1 5-ft. output cable (type RG 114/U)
1 185 ohm non-inductive resistor
1 185 ohm termination assembly
1 instruction manual





DETAILS of MAIN PULSE

Rutherford ELECTRONICS CO.
Telephone: TExas 0-4362
8944 LINDBLADE STREET
CULVER CITY, CALIFORNIA

WRITE FOR COMPLETE DATA ON THESE

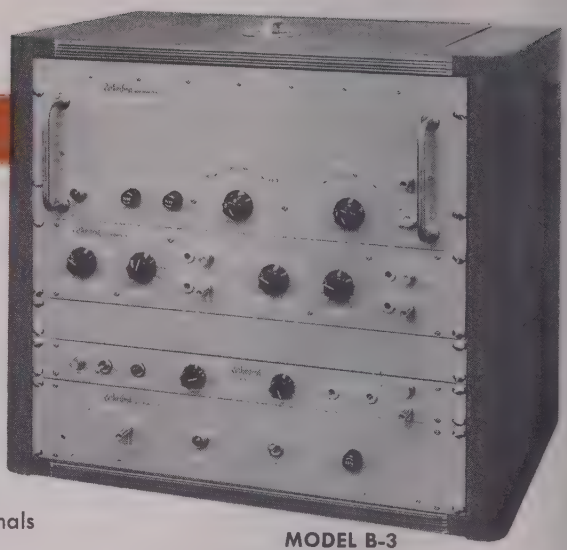
Rutherford PRECISION INSTRUMENTS

a ONE MEGACYCLE

PULSE GENERATOR

with CONTINUOUS CONTROL of REPETITION RATE, PULSE WIDTH, DELAY

The Rutherford Model B-3 Pulse Generator is a highly versatile, general-purpose instrument designed for applications involving repetition rates through one megacycle, delays from 0 to 10,000 μs, and fast rise time pulse outputs of positive or negative polarity and widths to 10,000 μs.



MODEL B-3

FEATURING:

- Pulses of either Positive or Negative polarity
- External triggering and push-button single pulse operation
- Excellent RF shielding to prevent the radiation of spurious signals
- Modular construction
- Adjustable rise time

SPECIFICATIONS

MAIN PULSE:

Widths: .08 to 10,000 microseconds

Polarity: pos. or neg. but not simultaneously

Amplitude: 20 V into 50-ohm load at 25% duty factor and 1 mc repetition rate. Amplitude increases with lower duty factors and repetition rate.

Attenuators: 50 db in 10 db steps and 10 db fill-in

Rise Time: less than 20 millimicroseconds; Fall Time: less than 25 millimicroseconds (both may simultaneously be degraded to 1 μs by single front panel control)

Overshoot and Undershoot: 4% maximum (when terminated with 50-ohm load)

Droop on Long Pulses: 10%

Duty Factor: 25% maximum at all repetition rates

INTERNAL OSCILLATOR:

Repetition Rate: 10 cycles to 1 megacycle in five decade ranges

TRIGGERING REQUIREMENTS:

External Trigger: may be triggered externally at rates from 0 to 1 megacycle

Trigger Required: 2-volt pos. or neg. pulse or 2-volt sine wave above 60 cycles per second

Single pulse control is provided

DELAY CONTROL:

Range: 0 to 10,000 microseconds

SYNCHRONIZING PULSES:

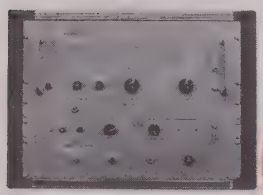
Amplitude: 10 volts minimum

Width: approximately .1 microsecond

Rise Time: approximately .05 microsecond

SIZE: 19" high, 22" wide, 18" deep

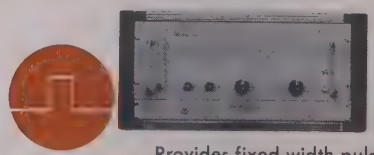
WEIGHT: 105 pounds



Provides fixed-width pulses from an internal oscillator

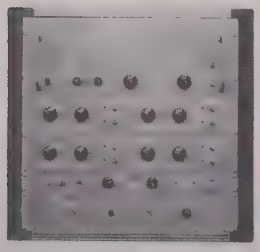
MODEL B-3-4

Individual units of the B-3 Pulse Generator can be assembled in many ways to provide pulses to the customer's requirements. A few combinations are shown here. We will gladly suggest assemblies for solution of your specific pulse handling problems.



MODEL B-3-5

Provides fixed-width pulses from external trigger

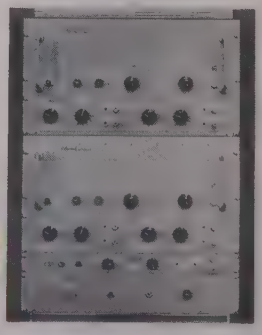


MODEL B-3-3

Provides double pulses when these three conditions exist: leading edge pulse-to-pulse is greater than 1 μs; trailing edge pulse to leading edge of next pulse is greater than .5 μs; duty factor does not exceed 25%

OTHER COMBINATIONS ARE AVAILABLE

WRITE FOR QUOTATIONS
ON RUTHERFORD HIGH REPETITION RATE
MULTIPLE-PULSE GENERATORS



MODEL B-3-2

Provides double pulses without restriction as to Pulse One position with respect to Pulse Two. Restricted to 1 megacycle repetition rate for each pulse of group, and to 25% duty factor for each pulse of group

ENGINEERED FOR ACCURACY, VERSATILITY AND CONVENIENCE

Rutherford PRECISION INSTRUMENTS

PULSE GENERATOR

A general-purpose instrument which produces pulses of accurately controlled widths, amplitude and time delay at low impedance

FEATURES:

• Internal oscillator gives repetition rates from 10 cycles to 100 kc • Pulse widths from .1 μs to 1,000 μs • Rise time of .02 μs • Internal delays to 10,000 μs • Accurate, easily legible multiturn controls • Can be triggered externally and for single pulse operation • Calibrating potentiometers are provided for each range • Five synchronizing pulses at various time intervals during single repetition period • 40 volts output into 93-ohm load

SPECIFICATIONS

MAIN PULSE:

Width Ranges: .1 to 1 μs, 1 to 100 μs; .5 to 10 μs, 10 to 1,000 μs

Duty Factor: limited by current capabilities of the output tube to 25%

Amplitude: at least 40 volts into 93-ohm load

Impedance: 93 ohm maximum

Rise Time: .02 μs between 10 % and 90% points

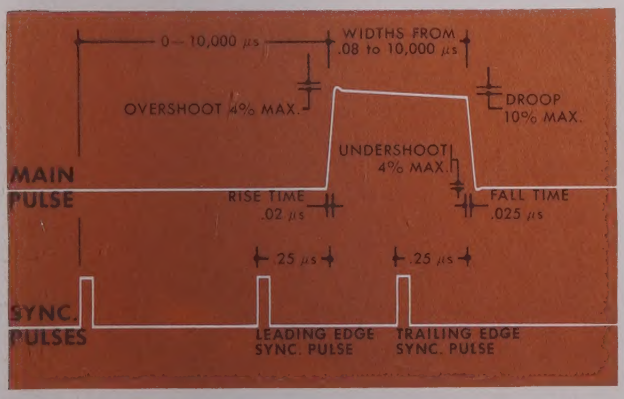
Fall Time: .02 μs

Overshoot and Undershoot: less than 4% with matched load

Droop: can be adjusted to less than 5%

Polarity of Main Output Pulse: pos. or neg.—but NOT simultaneously

NOTES ON B-3 WAVE



B-3 provides sync or timing signals in addition to a main pulse which has an exceptionally wide range of widths and delays.

FOR THE ELECTRONIC ENG

Rutherford

Precision Pulse Forming and Timing Instruments have achieved an enviable position in their field by virtue of

Sound Engineering

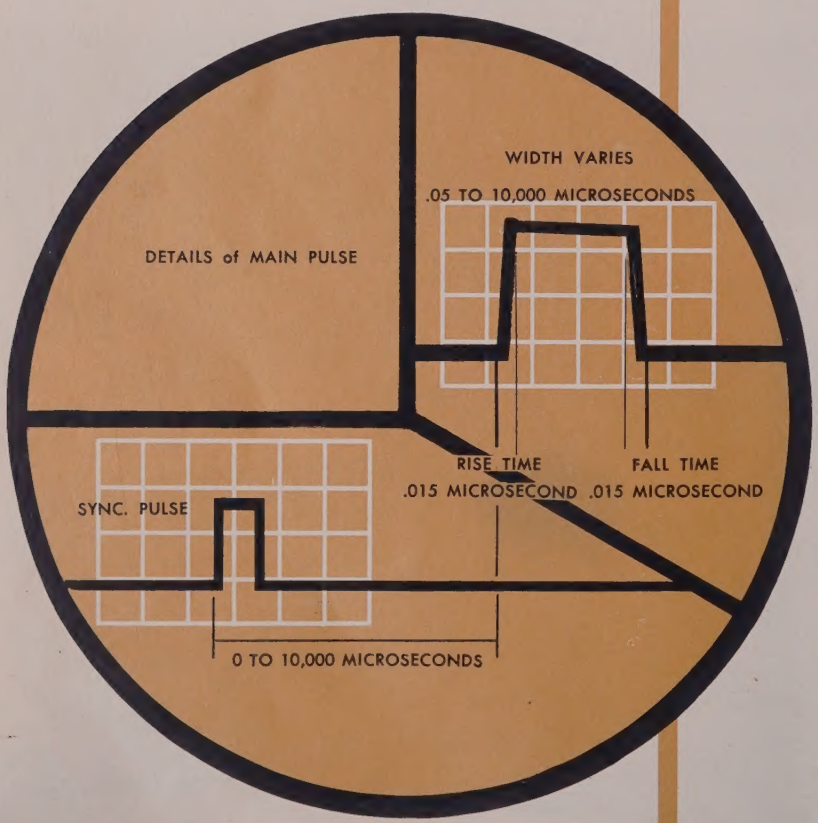
Careful Assembly

Simplified Operation

REPRESENTATIVES IN MAJOR CITIES OF THE WORLD

Other Rutherford instruments you might find useful in your laboratory:

1. High Repetition Rate Pulse Generators
2. Precision Time Delay Generators
3. General Purpose Pulse Generators
4. Versatile Modular Construction Pulse Generators
5. Special Design Pulse Instrumentation
6. 10 Megacycle Pulse Generators
7. Highly Accurate Pulse Generators
8. Variable Rise Time Generators
9. Low Jitter Pulse Generators
10. Multiple Pulse and Pulse Code Generators
11. Pulse Systems



SPECIFICATIONS

DELAY (with respect to Sync. Out):
0 to 1 microsecond
0 to 10 microseconds
0 to 100 microseconds
0 to 1,000 microseconds
0 to 10,000 microseconds

WIDTH (measured at 50% pulse amplitude
.05 to 1 microsecond
.1 to 10 microseconds
1 to 100 microseconds
10 to 1,000 microseconds
100 to 10,000 microseconds

REPETITION RATE:
20 c to 200 c
200 c to 2 kc
2 kc to 20 kc
20 kc to 200 kc
.2 mc to 2 mc

AMPLITUDE:
50 volts delivered to a 50 ohm resistive l

RISE TIME: 15 millimicroseconds

FALL TIME: 15 millimicroseconds

DUTY FACTOR:
30% duty factor at full amplitude. Ma
creased to 50% at reduced amplitu
automatic limiter is provided to protect
strument against accidental overload. A
cating lamp glows during operation.

ATTENUATION:
50 db in 10 db steps. 20 db continuous

EXTERNAL TRIGGER: Plus or minus 10 volts
minimum

SYNC OUT. (synchronizing pulse):
.05 microsecond wide. 10 volts amplitud
trigger in by .2 microsecond

SIZE: 19" wide, 8¾" high, 12" deep

WEIGHT: 43 pounds

POWER:
105—125 volts, 50—60 cycles, 350 w
5 amperes

PRICE: $670.00—f.o.b. Culver City, Calif.

ALL DATA SUBJECT TO CHANGE WITHOUT NOTICE. DEC. 1 1958

Rutherford
ELECTRONICS CO.
8944 LINDBLADE STREET
CULVER CITY, CALIFORNIA
TEXAS 0-7393

REPRESENTED IN YOUR TERRITORY BY

Rutherford

ELECTRONICS CO.